R-13 PERMIT APPLICATION

CONE Midstream Partners, LP > Oxford Station

Modification

R13-3208

Prepared By:

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March 2015

Project 153901.0007

Trinity Consultants

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1. INTRODUCTION

CONE Midstream Partners, LP (CONE) is submitting this modification application to the West Virginia Department of Environmental Protection (WVDEP) for a natural gas gathering facility located in Doddridge County, West Virginia, (Oxford Station). Specifically, this application seeks to authorize an increase in the current permit throughputs from 50 to 67 million standard cubic feet per day for the existing dehydration unit at the site (permitted under Permit no. R13-3208), as well as installation of one (1) additional dehydration unit with associated reboiler and vapor combustor, two (2) microturbine generators, three (3) produced fluids storage tanks, one electric vapor recovery unit (VRU) that will control emission, and one (1) blowdown flare.

1.1. FACILITY AND PROJECT DESCRIPTION

The Oxford Station is a natural gas gathering facility. Natural gas and liquids (condensate and water) from nearby wells will undergo dehydration before it is transported to a gathering line for additional processing. The station currently consists of the following equipment:

- One 50 MMSCFD triethylene glycol (TEG) dehydration unit with associated reboiler (rated at 1.00 MMBtu/hr) and enclosed vapor combustor (rated at 6.0 MMBtu/hr)
- One (1) 6,000 gallon produced fluids storage tank controlled by one (1) 9.20 MMBtu/hr vapor destruction unit (VDU-1)
- One (1) 324 horse power (hp) Cummins emergency generator

In anticipation of increased gas flow to the facility, CONE is proposing to install the following equipment;

- One (1) 400 bbl condensate storage tank controlled by the existing vapor destruction unit (VDU-1) and/or a vapor recovery unit (VRU-1)
- One (1) 400 bbl produced water storage tank controlled by VDU-1 and/or VRU-1
- One (1) 450 bbl gun barrel tank primarily controlled by one (1) electric vapor recovery unit or VDU-1 for control
- Two (2) natural gas fired microturbine generators (each rated at 200 kilowatts [kW])
- One (1) emergency blowdown flare (rated at 100 MMscfd)
- One (1) 67 MMSCFD dehydration unit with associated reboiler (rated at 1.00 MMBtu/hr) and enclosed vapor combustor (rated at 6.0 MMBtu/hr)

Additionally, this application:

- Seeks to increase the current permit throughput of the existing dehydration unit (SV-1) at the facility from 50 MMSCFD to 67 MMSCFD,
- Increase the condensate and produced water throughputs to 100 barrels per day (bbl/day) and 50 bbl/day, respectively, and
- Requests that the department remove the existing 6,000 gallon produced fluids storage tank (Tank -1) from the permit. The storage tank will be replaced by the three (3) proposed tanks.

A process flow diagram is included as Attachment F

1.2. R-13 APPLICATION ORGANIZATION

This R-13 permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: R-13 Application Forms;
- Attachment A: Business Certificate;
- Attachment B: Map;
- Attachment C: Installation and Start Up Schedule;
- Attachment D: Regulatory Discussion;
- Attachment E: Plot Plan;
- Attachment F: Detailed Process Flow Diagram;
- Attachment G: Process Description;
- Attachment I: Emission Units Table;
- Attachment J: Emission Points Data Summary Sheet;
- Attachment K: Fugitive Emissions Data Summary Sheet;
- Attachment L: Emissions Unit Data Sheets;
- Attachment M: Air Pollution Control Device Sheet;
- Attachment N: Supporting Emission Calculations;
- Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans
- Attachment P: Public Notice; and
- Application Fee.

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the Oxford Station, along with the methodology used for calculating emissions from the proposed new sources, are described in narrative form below. Detailed supporting calculations are also provided in Attachment N.

Emissions from the proposed project will result from the TEG dehydration unit, natural gas combustion in the reboiler, flares, microturbines, flashing, working, and breathing losses from the storage tanks, as well as emissions from loading of organic liquids into tank trucks. In addition, fugitive emissions from component leaks will result from the operation of the station. There will be no emissions associated with the vapor recovery unit as it is electrically powered. The methodologies employed in calculating emissions from these sources have been summarized below.

- **Reboiler:** Potential emissions from the proposed natural gas-fired reboiler of all criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas combustion equipment.[1] Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C.[2]
- **Dehydration Unit and Flare:** Potential emissions of HAPs, VOC, and methane from the dehydration units are calculated using GRI-GLYCalc. Note that the maximum pump rate (Kimray 45015 PV) is utilized in accordance with recent revisions in Subpart HH. Emissions of other criteria pollutants are calculated for natural gas combustion in the flare using U.S. EPA's AP-42 factors for external combustion of natural gas.[1] Greenhouse gas emissions from combustion in the flare are calculated according to the procedures in 40 CFR 98 Subpart C.
- **Microturbine Generators:** Potential emissions of NOX, CO, VOC, and carbon dioxide (CO2) are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for stationary gas turbines.
- **Storage Tanks:** Working, standing, and flash loss emissions of VOC and HAPs from the condensate/water stored in the tanks at the facility are calculated using ProMax® software.
- **Tank Truck Loading:** Emissions of VOC and HAPs from the loading of liquids from storage tanks to tank trucks are calculated using ProMax® software.

[1] U.S. EPA, AP 42, Fifth Edition, Volume I, Chapter 1.4, *Natural Gas Combustion,* Supplement D, July 1998.
[2] 40 CFR 98 Subpart C, *General Stationary Fuel combustion Sources*, Tables C-1 and C-2.

3. R13 APPLICATION FORM

The WVDEP permit application forms contained in this application include all applicable R13 application forms including the required attachments.

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

DIVISION OF AIR QUALITY

601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☐ **CONSTRUCTION** ☒ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office):*
CONE Midstream Partners LP

2. Federal Employer ID No. ***(FEIN):***
45-3344658

3. Name of facility *(if different from above):*
Oxford Station

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
1000 Consol Energy Drive

Canonsburg PA

5B. Facility's present physical address:
2123 Elliot Road West Union, WV 26456

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☐ **YES** ☒ **NO**

- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation:

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**

- If **YES,** please explain: CONE Midstream Partners purchased the property in 2014
- If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): Natural Gas Dehydration Facility

10. North American Industry Classification System **(NAICS)** code for the facility:
213112

11A. DAQ Plant ID No. (for existing facilities only):
017-00102

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):
R13-3208

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.

– For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
– For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B**.

From I-77 take exit 176. Turn right onto US-50 East. Travel 40.6 miles on US-50 East and turn right onto CR11. Travel 0.5 mile and turn on CR11/3. Travel 2.4 miles to site.

12.B. New site address (if applicable):	12C. Nearest city or town: West Union	12D. County: Doddridge
12.E. UTM Northing (KM): 4,343.7048	12F. UTM Easting (KM): 515.4689	12G. UTM Zone: 17

13. Briefly describe the proposed change(s) at the facility:
CONSOL is proposing to increase the throughput of the existing dehydration unit (50 MMSCFD to 67 MMSCFD) and installation of additional equipment that includes: 400 MW microturbine, electric vapor recovery unit, additional 67 MMSCFD dehydration unit, one (1) 100 MMscfd blowdown flare, and three 400 bbl storage tanks, increase throughput of storage tanks

14A. Provide the date of anticipated installation or change: / / – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: / /	14B. Date of anticipated Start-Up if a permit is granted: As soon as permitted

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year52

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17**. Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18**. Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known).* A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known).* Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) **.**
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

- ☒ Bulk Liquid Transfer Operations
- ☐ Chemical Processes
- ☐ Concrete Batch Plant
- ☐ Grey Iron and Steel Foundry
- ☐ Haul Road Emissions
- ☐ Hot Mix Asphalt Plant
- ☐ Incinerator
- ☐ Indirect Heat Exchanger
- ☐ Quarry
- ☐ Solid Materials Sizing, Handling and Storage Facilities
- ☒ Storage Tanks
- ☒ General Emission Unit, specify, Dehydration unit, Microturbines

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

- ☐ Absorption Systems
- ☐ Adsorption Systems
- ☐ Afterburner
- ☐ Baghouse
- ☐ Condenser
- ☐ Electrostatic Precipitator
- ☒ Flare
- ☐ Mechanical Collector
- ☐ Wet Collecting System
- ☒ Other Collectors, specify Electric Vapor Recovery Unit

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N,** or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

➢ Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33. **Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ **YES** ☒ **NO**

➢ If **YES,** identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***"Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment Q.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

- ☐ Authority of Corporation or Other Business Entity
- ☐ Authority of Partnership
- ☐ Authority of Governmental Agency
- ☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE ____ DATE: ____________________

(Please use blue ink) *(Please use blue ink)*

35B. Printed name of signee: Joseph Fink		35C. Title: Chief Operating Officer
35D. E-mail:	36E. Phone:	36F. FAX:
36A. Printed name of contact person (if different from above): David Morris		36B. Title: Air Quality Manager
36C. E-mail: DavidMorris@consolenergy.com	36D. Phone: 724-485-3063	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- ☒ **Attachment A: Business Certificate**
- ☒ **Attachment B: Map(s)**
- ☒ **Attachment C: Installation and Start Up Schedule**
- ☒ **Attachment D: Regulatory Discussion**
- ☒ **Attachment E: Plot Plan**
- ☒ **Attachment F: Detailed Process Flow Diagram(s)**
- ☒ **Attachment G: Process Description**
- ☐ **Attachment H: Material Safety Data Sheets (MSDS)**
- ☒ **Attachment I: Emission Units Table**
- ☒ **Attachment J: Emission Points Data Summary Sheet**
- ☒ **Attachment K: Fugitive Emissions Data Summary Sheet**
- ☒ **Attachment L: Emissions Unit Data Sheet(s)**
- ☐ **Attachment M: Air Pollution Control Device Sheet(s)**
- ☒ **Attachment N: Supporting Emissions Calculations**
- ☒ **Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans**
- ☒ **Attachment P: Public Notice**
- ☐ **Attachment Q: Business Confidential Claims**
- ☐ **Attachment R: Authority Forms**
- ☐ **Attachment S: Title V Permit Revision Information**
- ☒ **Application Fee**

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***
- ☐ ***For Title V Administrative Amendments:***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***
- ☐ ***For Title V Minor Modifications:***
  - ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***
- ☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***
  - ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
  - ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
  - ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

ATTACHMENT A

Current Business Certificate

ATTACHMENT B

Map

Figure 1 - Map of Oxford Station

ATTACHMENT C

Startup and Installation Schedule

ATTACHMENT C

Schedule of Planned Installation and Start-Up

Unit	Installation Schedule	Startup Schedule
Produced Fluids Storage Tanks (Tank-1) – To be removed	2015	Upon issuance of permit
67 MMSCFD Dehydration Unit – Throughput Increase (SV-1)	2015	Upon issuance of permit
67 MMSCFD Dehydration Unit (SV-2)	2015	Upon issuance of permit
Reboiler (BLR-2)	2015	Upon issuance of permit
Two (2) microturbine generator (TRB-1, TRB-2)	2015	Upon issuance of permit
Blowdown Flare (BDF-1)	2015	Upon issuance of permit
Gun Barrel Tank (Tank-1a)	2015	Upon issuance of permit
Produced fluids tank (Tank-3)	2015	Upon issuance of permit
Condensate Tank (Tank-2)	2015	Upon issuance of permit
Electric Vapor Recovery Unit (VRU) (VRU-1)	2015	Upon issuance of permit
Enclosed Vapor Combustor (CMB-2)	2015	Upon issuance of permit

ATTACHMENT D

Regulatory Discussion

ATTACHMENT D – REGULATORY APPLICABILITY

This section documents the applicability determinations made for Federal and State air quality regulations. The monitoring, recordkeeping, reporting, and testing plan is presented in Attachment O. In this section, applicability or non-applicability of the following regulatory programs is addressed:

- Prevention of Significant Deterioration (PSD) permitting;
- Title V of the 1990 Clean Air Act Amendments;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- West Virginia State Implementation Plan (SIP) regulations.

This review is presented to supplement and/or add clarification to the information provided in the WVDEP R13A permit application forms. In addition to providing a summary of applicable requirements, this section of the application also provides non-applicability determinations for certain regulations, allowing the WVDEP to confirm that identified regulations are not applicable to the Oxford Station. Note that explanations of non-applicability are limited to those regulations for which there may be some question of applicability specific to the operations at the Oxford Station. Regulations that are categorically non-applicable are not discussed (e.g., NSPS Subpart J, Standards of Performance for Petroleum Refineries).

Prevention of Significant Deterioration (PSD) Source Classification

Federal construction permitting programs regulate new and modified sources of attainment pollutants under Prevention of Significant Deterioration (PSD) and new and modified sources of non-attainment pollutants under Non-Attainment New Source Review (NNSR). PSD and NNSR regulations apply when a major source makes a change, such as installing new equipment or modifying existing equipment, and a significant increase in emissions results from the change. The Oxford Compressor Station is not a major source with respect to these programs since its potential emissions are below all the NNSR/PSD thresholds. As such, NNSR/PSD permitting is not triggered by this construction activity. CONE will monitor future construction activities at the site closely and will compare any future increase in emissions with the NSR/PSD thresholds to ensure these activities will not trigger this program.

Title V Operating Permit Program

Title 40 of the Code of Federal Regulations Part 70 (40 CFR 70) establishes the federal Title V operating permit program. West Virginia has incorporated the provisions of this federal program in its Title V operating permit program in West Virginia Code of State Regulations (CSR) 45-30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP, and 100 tpy of all other regulated pollutants.[1] The potential emissions of all regulated pollutants are below the corresponding threshold(s) at this facility. Therefore, the Oxford Station is not a major source for Title V purposes.

New Source Performance Standards

New Source Performance Standards (NSPS), located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable

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[1] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the Oxford Station.

NSPS Subparts K, Ka, and Kb

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka applies to those constructed, reconstructed, or modified prior to 1984. Both Subparts K and Ka apply to storage tanks with a capacity greater than 40,000 gallons. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m3 (~19,813 gallons). The produced water tank, condensate tank, and gun barrel tank at the Oxford Station have a capacity of 19,000 gallons or less. As such, Subparts K, Ka, and Kb do not apply to the storage tanks at the Oxford Station.

NSPS Subparts GG – Stationary Gas Turbines

Subpart GG – Standards of Performance for Stationary Gas Turbines, applies to stationary gas units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the lower heating value of the fuel, commencing construction after October 3, 1977. The proposed microturbine generators at the Oxford Station have a peak load of 200 kilowatts (2.28 MMBtu/hr) and as such, are not subject to this subpart.

NSPS Subparts KKKK – Stationary Combustion Turbines

Subpart KKKK – Standards of Performance for Stationary Combustion Turbines, applies to stationary combustion units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the higher heating value of the fuel, commencing construction after February 18, 2005. The proposed microturbine generators at the Oxford Station have a peak load of 200 kilowatts (2.28 MMBtu/hr) and as such, are not subject to this subpart.

NSPS Subpart OOOO—Crude Oil and Natural Gas Production, Transmission, and Distribution

Subpart OOOO – *Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution*, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, with an effective date of October 15, 2012. The list of potentially affected facilities includes:

- Gas wells
- Centrifugal compressors
- Reciprocating compressors
- Pneumatic controllers
- Storage vessels
- Equipment (as defined in §60.5430) located at onshore natural gas processing plants
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells

As part of this project, CONE is proposing to install three (3) storage tanks at the Oxford station. The produced water storage tank and condensate storage tank will each have potential VOC emissions less than 6 tpy, as such, these tanks will not be storage vessel affected facilities under this rule. The gun barrel tank will have potential VOC emissions greater than 6 tpy, as such, the gun barrel tank will be a storage vessel affected facility under this rule. CONE will comply with all applicable requirements under 60.5395.

CONE is not proposing to install any continuous natural gas driven pneumatic controllers or reciprocating compressors as part of this application.

Non-Applicability of All Other NSPS

NSPS are developed for particular industrial source categories. Other than NSPS developed for natural gas processing plants (Subpart OOOO), internal combustion engines (Subparts IIII and JJJJ), and associated equipment (Subparts D-Dc and K-Kb), the applicability of a particular NSPS to the Oxford Compressor Station can be readily ascertained based on the industrial source category covered. All other NSPS are categorically not applicable to natural gas compressor stations.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

Part 63 NESHAP allowable emission limits are established on the basis of a maximum achievable control technology (MACT) determination for a particular major source. A HAP major source is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. The Oxford Compressor Station will be an Area (minor) source of HAP since its potential emissions of HAP are less than the 10/25 major source thresholds. NESHAP apply to sources in specifically regulated industrial source categories (Clean Air Act Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type. Besides 40 CFR 63 Subpart A (NESHAP Subpart A), which is similar to 40 CFR 60 Subpart A (NSPS Subpart A), the following NESHAP could potentially apply to the Pandora

- 40 CFR Part 63 Subpart HH – Oil and Natural Gas Production Facilities
- 40 CFT Part 63 HHH – Natural Gas Transmission and Storage Facilities
- 40 CFR Part 63 Subpart JJJJJJ – Industrial, Commercial, and Institutional Boilers

The applicability of these NESHAP Subparts is discussed in the following sections.

40 CFR 63 Subpart HH – Oil and Natural Gas Production Facilities

This subpart applies to affected emission points that are located at facilities that are major and area sources of HAP and either process, upgrade, or store hydrocarbon liquids prior to custody transfer or that process, upgrade, or store natural gas prior to entering the natural gas transmission and storage source category. For purposes of this subpart, natural gas enters the natural gas transmission and storage source category after the natural gas processing plant, if present.

The Oxford station will be an area source of HAP emissions. The station will processes natural gas in its glycol dehydrator prior to the point of custody transfer; therefore, the provisions of NESHAP Subpart HH apply to the Oxford Station. The benzene emissions from the glycol dehydrator vents are less than 0.90 megagrams per year (1 tpy), therefore, the Oxford Station is exempt from the requirements of NESHAP Subpart HH pursuant to 40 CFR §63.764(e)(1)(ii), except for the requirement to keep records of the actual average natural gas flow rate or actual average benzene emissions from the dehydrator, per 40 CFR §63.774(d)(1).

40 CFR 63 Subpart HHH – Natural Gas Transmission and Storage Facilities

This standard applies to such units at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the production sector), but upstream of the distribution sector. The Oxford Station is not a transmission facility; therefore, the provisions of NESHAP Subpart HHH do not apply to the Oxford Station

40 CFR 63 Subpart JJJJJJ – Industrial, Commercial, and Institutional Boilers (Area Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types. The proposed reboiler and microturbines at the Oxford is natural gas-fired and is specifically exempt from this subpart. Therefore, no sources at the Oxford Station are subject to any requirements under 40 CFR 63 Subpart JJJJJJ

West Virginia SIP Regulations

The Oxford Station is potentially subject to regulations contained in the West Virginia Code of State Regulations, Chapter 45 (Code of State Regulations). The Code of State Regulations fall under two main categories, those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., PM standards for manufacturing equipment).

45 CSR 2: Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The reboiler and microturbine are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from this unit shall not exceed 10 percent based on a six minute block average. Per 45 CSR 2-4, PM emissions from this unit will not exceed a level of 0.09 multiplied by the heat design input in MMBtu/hr of the unit.

45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

The Oxford station is generally subject to this requirement. However, due to the nature of the process at the station, production of objectionable odor from the compressor station during normal operation is unlikely.

45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The proposed enclosed flares are incinerators and therefore must comply with this regulation. Per 45 CSR 6-4.3, opacity of emissions from this unit shall not exceed 20 percent, except as provided by 6-4.4. PM emissions from this unit will not exceed the levels calculated in accordance with 6-4.1.

45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As such, by complying with all applicable requirements of 40 CFR Part 60 at the Oxford Station, CONE will be complying with 45 CSR 16.

45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.

Due to the nature of the activities at the Oxford Station it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions. However, CONE will take measures to ensure any fugitive particulate matter emissions will not cross the property boundary should any such emissions occur.

45 CSR 21-28: Petroleum Liquid Storage in Fixed Roof Tanks

45 CSR 21-28 applies to any fixed roof petroleum liquid storage tank with a capacity greater than 40,000 gallons. The capacity of the new storage tanks proposed for the Oxford Station is less than 40,000 gallons; therefore, 45 CSR 21-28 will not apply.

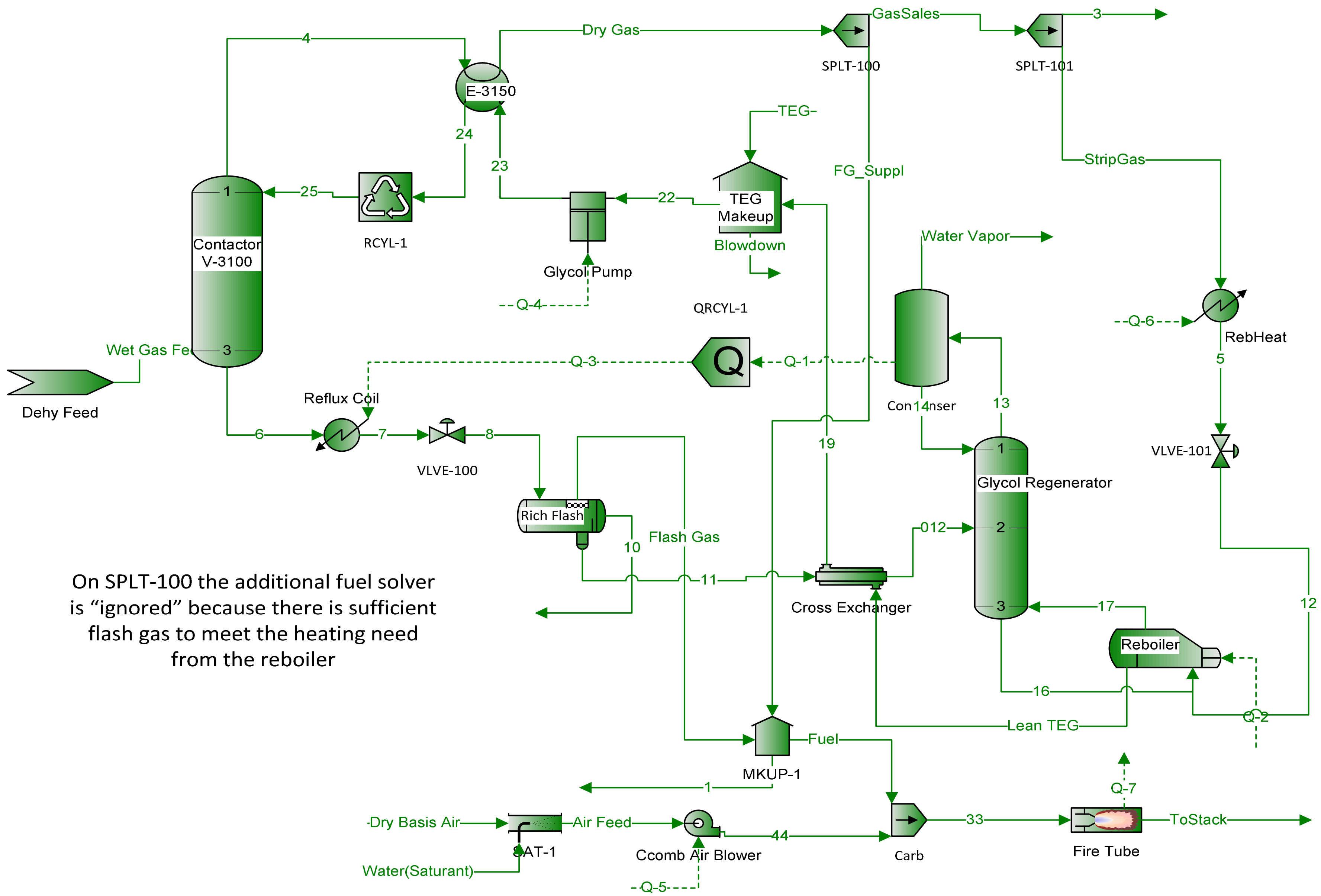
ATTACHMENT E

Plot Plan

ATTACHMENT F

Detailed Process Flow Diagram

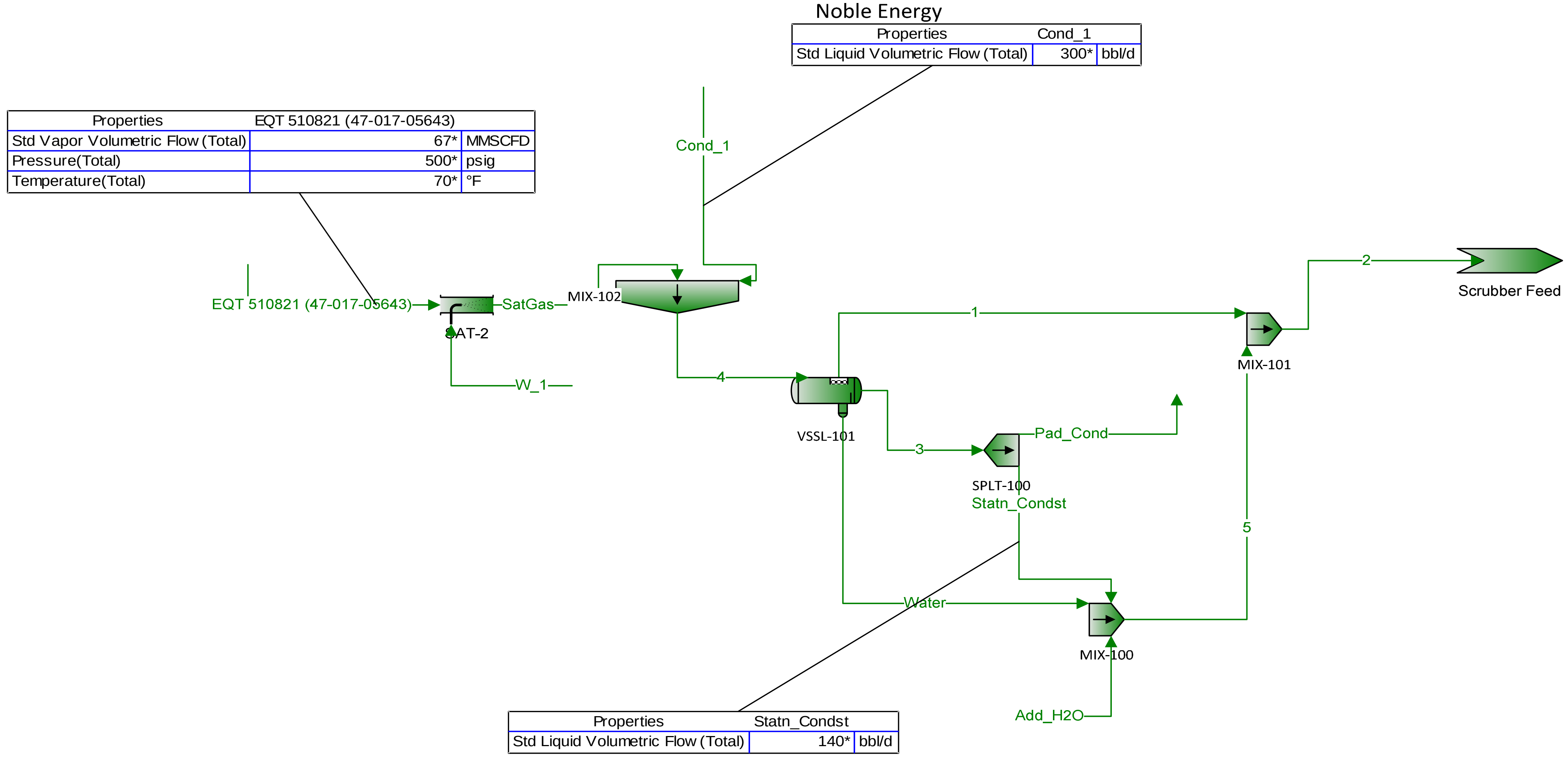
OXFORD STATION
DEHY



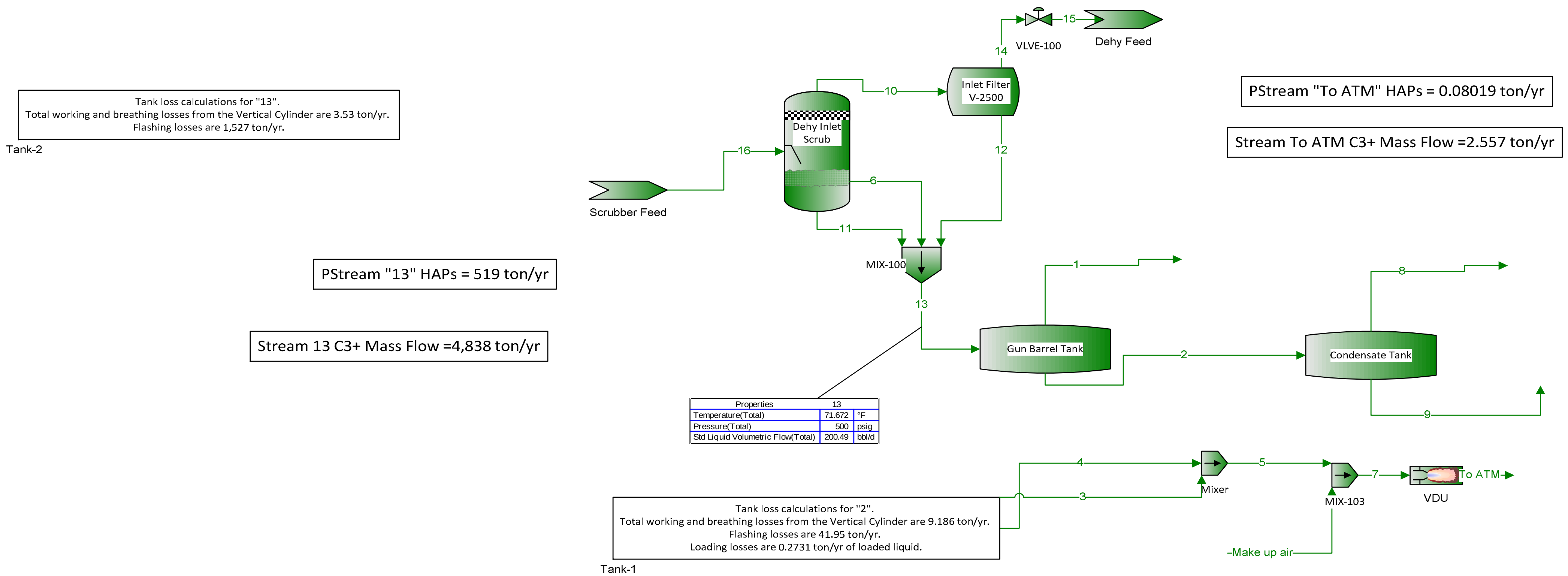
On SPLT-100 the additional fuel solver is “ignored” because there is sufficient flash gas to meet the heating need from the reboiler

Stream ToStack C3+ Mass Flow =0.7519 ton/yr

Oxford Pad
Noble Energy



OXFORD STATION
CONE Inlet



Properties	13	
Temperature(Total)	71.672	°F
Pressure(Total)	500	psig
Std Liquid Volumetric Flow(Total)	200.49	bbl/d

ATTACHMENT G

Process Description

ATTACHMENT G – PROCESS DESCRIPTION

CONE is proposing to increase the current permit limits of the existing dehydration unit (50 MMSCFD to 67 MMSCFD) and facility wide liquid throughputs, in addition to installing the following equipment: one (1) electric vapor recovery unit, one (1) blowdown flare, two (2) natural gas fired microturbine generators (each rated at 200KW), one (1) 67 MMSCFD dehydration unit with associated reboiler and enclosed ground flare, and three miscellaneous storage tanks (each 18,900 gallons or less)

Natural gas from the field comes into the pig receiver area. In non-pigging situations, the gas bypasses the pig receiver and flows through a meter and then through the discharge scrubber. From the discharge scrubber, the gas goes through an inlet filter and then through the glycol contactor bottom to top, coming into contact with lean glycol travelling from the top down, with the glycol absorbing the water in the gas. The gas leaves the contactor going through a glycol/gas exchanger, cooling the lean glycol coming in. The gas then goes through an after contactor coalescer removing any entrained glycol, after which the gas goes into sales.

The rich glycol leaves the bottom of the contactor, goes into the low pressure side of the Kimray pump, pumped through the still column exchanger for preheat, then makes one pass through the glycol exchanger, then flows through the flash tank where gas is flashed off (gas used for dehy fuel, excess goes to enclosed vapor combustor), then through a charcoal filter, then four (4) passes through glycol exchanger and into the reboiler.

The lean glycol comes out of the reboiler after the water has been evaporated off into the still column, goes through the glycol exchanger, makes five (5) passes onto a sock filter, into the high pressure side of the Kimray pump where lean glycol is then pumped through the glycol/gas exchanger and then into the top contactor. Water is vaporized in the reboiler, leaves the vapor stack, travels to the enclosed vapor combustor, where it is burned along with the flash gas and supplemental fuel. Hydrocarbons in the vapor, flash, and fuel are destroyed at a 98% efficiency.

The natural gas stream from the contact tower flows into the pipeline to be transported further along the pipeline system. The station will be equipped with one (1) produced water tank, one (1) condensate storage tank, and one (1) gun barrel tank. Emissions from the gun barrel tank will be controlled by an electric vapor recovery unit (VRU) with vapor destructive unit [VDU] backup while emission from the condensate and produced storage tanks are controlled by either the VRU or VDU. Once the tanks (condensate and produced water) are filled, the contents are loaded into trucks for transport. Truck loading is vapor balanced and controlled by the VDU.

A process flow diagram is included as Attachment D.

ATTACHMENT I

Emission Units Table

Attachment I

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device [4]
Tank-1	VDU-1	Produced Fluids Tank	2014	6,000 gallon	Removed	VDU-1
Tank-1a	VRU-1 or VDU-1	Gun Barrel Tank	2015	18,900 gallons	New	VRU-1 or VDU-1
Tank-2	VDU-1	Condensate Storage Tank	2015	16,800 gallons	New	VRU-1 or VDU-1
Tank -3	VDU-1	Produced Water Storage Tank	2015	16,800 gallons	New	VRU-1 or VDU-1
VRU-1	VRU-1	Electric Vapor Recovery Unit	2015	N/A	New	None
BDF-1	BDF-1	Blowdown Flare	2015	100 MMScfd	New	None
CMB-2	CMB-2	Enclosed Vapor Combustor	2015	6 MMbtu/hr	New	None
SV-2	CMB-2	Dehydration Unit (Still Vent and Flash Tank)	2014	67 MMSCFD	New	CMB-2
BLR-2	VS-2	Dehydrator Reboiler	2015	1 MMBtu/hr	New	None
TRB-1	VS-4	Microturbine generator	2015	200 kW	New	None
TRB-2	VS-5	Microturbine generator	2015	200 kW	New	None
SV-1	CMB-1	Dehydration Unit (Still Vent and Flash Tank)	2014	67 MMSCFD	Modified – Increased throughput	CMB-1
BLR-1	VS-1	Dehydrator Reboiler	2014	1 MMBtu/hr	Existing	None
CMB-1	CMB-1	Enclosed Vapor Combustor	2014	6 MMbtu/hr	Existing	None
VDU-1	VDU-1	Vapor Destruction Unit	2014	9.21 MMbtu/hr	Existing	None
BL-1	VDU-1	Liquids Loading	2014	~ 2,300,000 gal/yr	Modified – Increased throughput	VDU-1
EG-1	VS-3	Cummins Generator	2014	335 HP	Existing	None

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

ATTACHMENT J

Emission Points Data Summary Sheet

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions [4]		Maximum Potential Controlled Emissions [5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used [6]	Emission Concentration [7] (ppmv or mg/m[4])
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
CMB-1, CMB-2 (each dehy)	Upward Vertical Stack	SV-1, SV-2	Dehydration Unit (each Dehydrator)	CMB-1, CMB-2	Ground Combustor	NA	NA	VOC HAP CO2e	56.94 13.47 1,132	249.38 58.99 4,957	1.25 0.30 26	5.49 1.30 112	Gas/Vapor	O[B]	
VRU-1 or VDU-1	Upward Vertical Stack	Tank-1a	Gun Barrel Storage Tank	VRU-1 or VDU-1	Vapor recovery unit or Vapor destruction Unit	NA	NA	VOC HAP	349.52 32.99	1,530.91 144.51	17.48 1.65	76.55 7.23	Gas/Vapor	O[C]	
VRU-1 or VDU-1	Upward Vertical Stack	Tank-2, Tank- 3	Storage Tank (Total tank)	VRU-1 or VDU-1	Vapor destruction unit	NA	NA	VOC HAP	11.68 0.73	51.14 3.21	0.58 0.04	2.56 0.16	Gas/Vapor	O[C]	
VS-1, VS-2 (each reboiler)	Upward Vertical Stack	BLR-1, BLR-2	Reboilers (each reboiler)	NA	NA	NA	NA	NOx CO PM/PM10/PM2.5 SO2 VOC CO2e	0.08 0.07 0.01 <0.001 0.004 117	0.35 0.29 0.03 0.002 0.02 513	0.08 0.07 0.01 <0.001 0.004 117	0.35 0.29 0.03 0.002 0.02 513	Gas/Vapor	O[D] O[D] O[D] O[D] O[A]	
CMB-1, CMB-2 (each combustor)	Upward Vertical Stack	CMB-1, CMB-2	Ground Combustors (each combustor)	NA	NA	NA	NA	NOx CO PM/PM10/PM2.5 SO2 CO2e	0.47 0.40 0.04 0.003 718	2.08 1.74 0.16 0.01 3,143	0.47 0.40 0.04 0.003 718	2.08 1.74 0.16 0.01 3,143	Gas/Vapor	O[D] O[D] O[D] O[D] O[A]	
VS-4; VS-5 (each turbine)	Upward Vertical Stack	TRB-1, TRB-2	Microturbine generators (each turbine)	NA	NA	NA	NA	NOx CO PM/PM10/PM2.5 SO2 CO2e	0.08 0.22 0.02 0.008 266	0.35 0.96 0.07 0.03 1,166	0.08 0.22 0.02 0.008 266	0.35 0.96 0.07 0.03 1,166	Gas/Vapor	O[D] O[D] O[D] O[D] O[A]	
VDU-1	Upward Vertical Stack	VDU-1	Vapor Destruction Unit	NA	NA	NA	NA	NOx CO PM/PM10/PM2.5 SO2 CO2e	0.73 0.61 0.06 0.004 1,096	3.19 2.68 0.24 0.02 4,801	0.73 0.61 0.06 0.004 1,096	3.19 2.68 0.24 0.02 4,801	Gas/Vapor	O[D] O[D] O[D] O[D] O[A]	

VS-3	Upward Vertical Stack	EG-1	Emergency Generator	NA	NA	NA	NA	NOx CO PM/PM10/PM2.5 VOC	1.78 0.5 0.06 0.36	0.45 0.12 0.02 0.09	1.78 0.5 0.06 0.36	0.45 0.12 0.02 0.09	Gas/Vapor	Man. Data	
VDU-1	Upward Vertical Stack	BL-1	Liquids Loading	VDU-1	Vapor Destruction Unit	NA	NA	VOC HAP	0.03 0.00	0.11 0.00	0.03 0.00	0.11 0.00	Gas/Vapor	O	
BDF-1 (pilot only)	Upward Vertical Stack	BDF-1	Blowdown Flare	NA	Flare	NA	NA	NOx CO PM/PM10/PM2.5 SO2 CO2e	0.01 0.01 0.00 0.00 19.96	0.06 0.05 0.00 0.00 87	0.01 0.01 0.00 0.00 19.96	0.06 0.05 0.00 0.00 87	Gas/Vapor	O[E] O[E] O[E] O[E] O[A]	

A- 40 CFR 98, Subpart C for natural gas fired combustion.
B- GRI-GLYCalc
C- Bryan and Research Engineering Promax Software
D- AP-42 Section 1.4 Tables 1.4-1, 1.4-2 and 1.4-3, July 1998.
E- AP-42 Section 13.5, 1991

The EMISSION POINTS DATA SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[6] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

[7] Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (ºF)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.

ATTACHMENT K

Fugitive Emissions Data Summary Sheet

Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☐ Yes ☒ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☐ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered “NO” to all of the items above, it is not necessary to complete the following table, “Fugitive Emissions Summary.”

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads	NA	--	--	--	--	--
Unpaved Haul Roads	NA	--	--	--	--	--
Storage Pile Emissions	NA	---	---	---	---	---
Loading/Unloading Operations	VOC HAP	N/A	0.12 6.72E-4	N/A	0.12 6.72E-4	O[B]
Wastewater Treatment Evaporation & Operations	NA	---	---	---	---	---
Equipment Leaks	VOC	N/A	4.46	N/A	4.46	O[A]
General Clean-up VOC Emissions	NA	---	---	---	---	---
Other	NA	---	---	---	---	---

A – Same as current PTE.
B- Bryan Research Engineering Promax Software

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

ATTACHMENT L

Emission Unit Data Sheet

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): TRB -1, TRB-2

1.	Name or type and model of proposed affected source: Capstone C200 microturbine generators
2.	On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3.	Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4.	Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Electrical generation from natural gas.
5.	Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

natural gas – 1,738 scf/hr (each), 15.2 MMscf/yr (each) (assuming 1265 Btu/scf)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

natural gas

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

2.28 MMBtu/hr stationary gas turbine (each)

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.28 $\times 10^6$ BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ 588 °F and 14.7 psia

a.	NO_X	0.08	lb/hr	grains/ACF
b.	SO_2	0.008	lb/hr	grains/ACF
c.	CO	0.22	lb/hr	grains/ACF
d.	PM_{10}	0.02	lb/hr	grains/ACF
e.	Hydrocarbons	0.02	lb/hr	grains/ACF
f.	VOCs	0.02	lb/hr	grains/ACF
g.	Pb	NA	lb/hr	grains/ACF
h.	Specify other(s)			
	Benzene	2.74E-05	lb/hr	grains/ACF
	Toluene	2.96E-04	lb/hr	grains/ACF
	Xylene	1.46E-04	lb/hr	grains/ACF
	Formaldehyde	1.62E-03	lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None.	None.
REPORTING	TESTING
None.	None.

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

See attached manufacturer's specification sheet

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*):

1. Loading Area Name: BL-1 (Liquids Loading)

2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply):
☐ Drums ☐ Marine Vessels ☐ Rail Tank Cars ☒ Tank Trucks

3. Loading Rack or Transfer Point Data:

Number of pumps	1
Number of liquids loaded	1
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	1

4. Does ballasting of marine vessels occur at this loading area?
☐ Yes ☐ No ☒ Does not apply

5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point:

Produced Water being pumped into tanks

6. Are cargo vessels pressure tested for leaks at this or any other location?
☐ Yes ☒ No

If YES, describe:

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.
hours/day	24	24	24	24
days/week	7	7	7	7

weeks/quarter	13	13	13	13

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.							
Liquid Name		Produced fluids					
Max. daily throughput (1000 gal/day)		variable					
Max. annual throughput (1000 gal/yr)		2,300					
Loading Method [1]		Vapor balanced					
Max. Fill Rate (gal/min)							
Average Fill Time (min/loading)							
Max. Bulk Liquid Temperature (^{o}F)		~72					
True Vapor Pressure [2]							
Cargo Vessel Condition [3]		Cleaned					
Control Equipment or Method [4]		VB, TO					
Minimum control efficiency (%)		96.73					
Maximum Emission Rate	Loading (lb/hr)	~0.06 lb/hr VOC & 0.002 lb/hr HAP					
	Annual (lb/yr)	~546 lb/yr VOC & 18 lb/yr HAP					
Estimation Method [5]		Bryan Research Engineering Promax Software					

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration
CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system)
O = other (descibe)

[5] EPA = EPA Emission Factor as stated in AP-42
MB = Material Balance

TM = Test Measurement based upon test data submittal O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing** Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.	
MONITORING All connections during loading operation	RECORDKEEPING Volume of water loaded from tank
REPORTING None	TESTING None
MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.	
RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.	
REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.	
TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.	
10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty	

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): SV-1, SV-2

1. Name or type and model of proposed affected source: 67 MMSCFD dehydration unit with 1.00 MMbtu/hr duty (Heat Input rated) reboiler (each)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: 67 million standard cubic feet per day of natural gas, each
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce a material – removes water from wet natural gas
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas in reboiler

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Reboiler - Natural gas – 790 scf/hr (each)   6.92 MMscf/yr (assuming 1265 Btu/scf)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

natural gas fired external combustion heater – 1.00 MMbtu/hr input rating

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 1.00 $\times 10^6$ BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	0.08 lb/hr		grains/ACF
b.	SO_2	<0.001 lb/hr		grains/ACF
c.	CO	0.07 lb/hr		grains/ACF
d.	PM_{10}	0.01 lb/hr		grains/ACF
e.	Hydrocarbons	lb/hr		grains/ACF
f.	VOCs	56.94 lb/hr		grains/ACF
g.	Pb	lb/hr		grains/ACF
h.	Specify other(s)			
	HAP	13.47 lb/hr		grains/ACF
		lb/hr		grains/ACF
		lb/hr		grains/ACF
		lb/hr		grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
Throughput of wet natural gas. Operating parameters of dehydration unit for GLYCalc (temperature, pressure, glycol flow rate)	Annual benzene emissions calculated with GLYCalc.
REPORTING None.	TESTING None.

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Oxford Station	2. Tank Name Gun Barrel Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) Tank-1a	4. Emission Point Identification No. (as assigned on *Equipment List Form*) Tank-1a
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? ☐ Yes ☒ No (e.g. Is there more than one product stored in the tank?)	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode). Separates a mix of condensate and water	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 18,900 gallons	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 22.5
10A. Maximum Liquid Height (ft) 20	10B. Average Liquid Height (ft) 10
11A. Maximum Vapor Space Height (ft) TBD	11B. Average Vapor Space Height (ft) TBD
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 450 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
2,300,000	~6,300

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume)
~137

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
- ☒ Fixed Roof _X_ vertical __ horizontal ___ flat roof _X_ cone roof __ dome roof ___ other (describe)
- ☐ External Floating Roof ___ pontoon roof ___ double deck roof
- ☐ Domed External (or Covered) Floating Roof
- ☐ Internal Floating Roof ___ vertical column support ___ self-supporting
- ☐ Variable Vapor Space ___ lifter roof ___ diaphragm
- ☐ Pressurized ___ spherical ___ cylindrical
- ☐ Underground
- ☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) welded panels

20A. Shell Color White	20B. Roof Color White	20C. Year Last Painted 2014

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): 0

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH

BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL

BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL

BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL

PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT

SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL

WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER

WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT

WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)

OPEN:	90% CLOSED:

STUB DRAIN

1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Huntington, WV
28. Daily Average Ambient Temperature (°F)
29. Annual Average Maximum Temperature (°F) 65.3
30. Annual Average Minimum Temperature (°F) 45
31. Average Wind Speed (miles/hr)
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))
33. Atmospheric Pressure (psia)

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: 59.97	
34A. Minimum (°F)	34B. Maximum (°F) 67.12
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 63.19	37B. Corresponding Vapor Pressure (psia)
38A. Maximum Liquid Surface Temperature (°F) 72.44	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A. Material Name or Composition	Condensate & Produced Water		
39B. CAS Number			
39C. Liquid Density (lb/gal)			
39D. Liquid Molecular Weight (lb/lb-mole)			
39E. Vapor Molecular Weight (lb/lb-mole)			

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	TBD TBD		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

☐ Carbon Adsorption[1]
☐ Condenser[1]
☒ Conservation Vent (psig)
Vacuum Setting 5.0 oz   Pressure Setting 12.0 oz
☐ Emergency Relief Valve (psig)
☐ Inert Gas Blanket of
☐ Insulation of Tank with
☐ Liquid Absorption (scrubber)[1]
☐ Refrigeration of Tank
☐ Rupture Disc (psig)
☒ Vent to Incinerator[1] - Vapor Destruction Unit (backup)
☒ Other[1] (describe): Electric Vapor Recovery Unit

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
See attached Emissions Calculation					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for <u>each</u> new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Oxford Station	2. Tank Name Produced water and condensate tanks
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) Tank-2 & Tank -3	4. Emission Point Identification No. (as assigned on *Equipment List Form*) Tank 2& Tank 3
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? ☐ Yes ☒ No (e.g. Is there more than one product stored in the tank?)	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 16,800 gallons (each)	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 20
10A. Maximum Liquid Height (ft) 20	10B. Average Liquid Height (ft) 20
11A. Maximum Vapor Space Height (ft) TBD	11B. Average Vapor Space Height (ft) TBD
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 400 bbl (each)	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
1,533, 000 - condensate 766,500 - produced water	~4,200 condensate ~2,100 produced water

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume)

~91 (condensate)
~ 46 (produced water)

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☒ Bottom Loading (one is loaded each way)

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):

☒ Fixed Roof _X_ vertical __ horizontal ___ flat roof _X_ cone roof __ dome roof ___ other (describe)
☐ External Floating Roof ___ pontoon roof ___ double deck roof
☐ Domed External (or Covered) Floating Roof
☐ Internal Floating Roof ___ vertical column support ___ self-supporting
☐ Variable Vapor Space ___ lifter roof ___ diaphragm
☐ Pressurized ___ spherical ___ cylindrical
☐ Underground
☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) welded panels

20A. Shell Color White	20B. Roof Color White	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): 0

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Huntington, WV
28. Daily Average Ambient Temperature (°F)
29. Annual Average Maximum Temperature (°F) 65.3
30. Annual Average Minimum Temperature (°F) 45
31. Average Wind Speed (miles/hr)
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))
33. Atmospheric Pressure (psia)

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: 59.97	
34A. Minimum (°F)	34B. Maximum (°F) 67.12
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 59.97	37B. Corresponding Vapor Pressure (psia)
38A. Maximum Liquid Surface Temperature (°F) 67.12	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A. Material Name or Composition	Condensate + Produced Water		
39B. CAS Number	68919-39-1		
39C. Liquid Density (lb/gal)			
39D. Liquid Molecular Weight (lb/lb-mole)			
39E. Vapor Molecular Weight (lb/lb-mole)			

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	TBD TBD		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting   Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☒ Vent to Incinerator[1] - Vapor Destruction Unit (VDU-1)
- ☒ Other[1] (describe): Vapor Recovery Unit (VRU-1)

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
See attached Emissions Calculation					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

ATTACHMENT M

Air Pollution Control Device Sheet

Attachment M
Air Pollution Control Device Sheet
(OTHER COLLECTORS)

Control Device ID No. (must match Emission Units Table): C4 & C5 (Vapor Recovery Units)

Equipment Information

1. Manufacturer: Model No.	2. Control Device Name: VRU-1 Type: Electric Vapor Recovery Unit

3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.

4. On a separate sheet(s) supply all data and calculations used in selecting or designing this collection device.

5. Provide a scale diagram of the control device showing internal construction.

6. Submit a schematic and diagram with dimensions and flow rates.

7. Guaranteed minimum collection efficiency for each pollutant collected:

VOC- 95% - assume 5% downtime
HAP-95% - assume 5% downtime

8. Attached efficiency curve and/or other efficiency information.

9. Design inlet volume: N/A SCFM	10. Capacity: NA

11. Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

NA

12. Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment. N/A

13. Description of method of handling the collected material(s) for reuse of disposal.

N/A

Gas Stream Characteristics

14. Are halogenated organics present? ☐ Yes ☒ No
Are particulates present? ☐ Yes ☒ No
Are metals present? ☐ Yes ☒ No

15. Inlet Emission stream parameters:	**Maximum**	**Typical**
Pressure (mmHg):	38.86 mmHg	
Heat Content (BTU/scf):		
Oxygen Content (%):	<12.0 analyzer is alarmed	
Moisture Content (%):		
Relative Humidity (%):		

16. Type of pollutant(s) controlled: ☐ SO$_x$ ☐ Odor ☐ Particulate (type): ☒ Other (all hydrocarbons)	
17. Inlet gas velocity: ft/sec	18. Pollutant specific gravity:
19. Gas flow into the collector: ACF @ and PSIA	20. Gas stream temperature: Inlet: < 65 °F Outlet: < 90 °F
21. Gas flow rate: Design Maximum: ACFM Average Expected: ACFM	22. Particulate Grain Loading in grains/scf: Inlet: Outlet:

23. Emission rate of each pollutant (specify) into and out of collector:

Pollutant	**IN Pollutant**		**Emission Capture Efficiency %**	**OUT Pollutant**		**Control Efficiency %**
	lb/hr	**grains/acf**		**lb/hr**	**grains/acf**	
A VOC	350		100	17.5		95
B HAP	33		100	1.6		95
C						
D						
E						

24. Dimensions of stack: Height ft. Diameter ft.

25. Supply a curve showing proposed collection efficiency versus gas volume from 25 to 130 percent of design rating of collector.

Particulate Distribution

26. Complete the table:	**Particle Size Distribution at Inlet to Collector**	**Fraction Efficiency of Collector**
Particulate Size Range (microns)	**Weight % for Size Range**	**Weight % for Size Range**
0 – 2		
2 – 4		
4 – 6		
6 – 8		
8 – 10		
10 – 12		
12 – 16		
16 – 20		
20 – 30		
30 – 40		
40 – 50		
50 – 60		
60 – 70		
70 – 80		
80 – 90		
90 – 100		
>100		

27. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification): None

28. Describe the collection material disposal system: N/A

29. Have you included ***Other Collectors Control Device*** in the Emissions Points Data Summary Sheet?

30. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING: Monthly AVO closed vent system inspections per NSPS Subpart OOOO	RECORDKEEPING: Records of inspections
REPORTING: Annual reports of deviations	TESTING: None

MONITORING:	Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

31. Manufacturer’s Guaranteed Control Efficiency for each air pollutant.
>95% for VOC, 95% for HAP

32. Manufacturer’s Guaranteed Control Efficiency for each air pollutant.

33. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

Attachment M
Air Pollution Control Device Sheet
(FLARE SYSTEM)

Control Device ID No. (must match Emission Units Table): BDF-1

Equipment Information

1. Manufacturer: Zeeco Model No.	2. Method: ☒ Elevated flare ☐ Ground flare ☐ Other Describe Combustor
3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
4. Method of system used: ☐ Steam-assisted ☐ Air-assisted ☐ Pressure-assisted ☒ Non-assisted	
5. Maximum capacity of flare: scf/min 4.2 MM scf/hr	6. Dimensions of stack: Diameter 3 ft. Height 20 ft.
7. Estimated combustion efficiency: (Waste gas destruction efficiency) Estimated: 98 % Minimum guaranteed: 98 %	8. Fuel used in burners: ☒ Natural Gas ☐ Fuel Oil, Number ☐ Other, Specify:
9. Number of burners: Rating: 100 MMscfd	11. Describe method of controlling flame: A thermocouple is present
10. Will preheat be used? ☐ Yes ☒ No	
12. Flare height: 100 ft	14. Natural gas flow rate to flare pilot flame per pilot light: scf/min 130 scf/hr
13. Flare tip inside diameter: ft	
15. Number of pilot lights: 2 Total ~ 0.14 BTU/hr	16. Will automatic re-ignition be used? ☒ Yes ☐ No
17. If automatic re-ignition will be used, describe the method: Electrical restart	
18. Is pilot flame equipped with a monitor? ☒ Yes ☐ No If yes, what type? ☒ Thermocouple ☐ Infra-Red ☐ Ultra Violet ☐ Camera with monitoring control room ☐ Other, Describe:	
19. Hours of unit operation per year: 8760 (pilot only)	

Steam Injection

20. Will steam injection be used? ☐ Yes ☒ No	21. Steam pressure PSIG Minimum Expected: Design Maximum:
22. Total Steam flow rate: LB/hr	23. Temperature: °F
24. Velocity ft/sec	25. Number of jet streams
26. Diameter of steam jets: in	27. Design basis for steam injected: LB steam/LB hydrocarbon
28. How will steam flow be controlled if steam injection is used?	

Characteristics of the Waste Gas Stream to be Burned

29.

Name	Quantity Grains of H_2S/100 ft^3	Quantity (LB/hr, ft^3/hr, etc)	Source of Material
See attached emissions calculations			

30. Estimate total combustible to flare: ~240,000 (design value) LB/hr (Maximum mass flow rate of waste gas) scfm	
31. Estimated total flow rate to flare including materials to be burned, carrier gases, auxiliary fuel, etc.:	
32. Give composition of carrier gases: See attached design information	
33. Temperature of emission stream: 120 °F Heating value of emission stream: ~1200 BTU/ft^3 Mean molecular weight of emission stream: MW = 22.08	34. Identify and describe all auxiliary fuels to be burned. BTU/scf BTU/scf BTU/scf BTU/scf BTU/scf
35. Temperature of flare gas: °F	36. Flare gas flow rate: scf/min
37. Flare gas heat content: ~1200 (design) BTU/ft^3	38. Flare gas exit velocity: scf/min
39. Maximum rate during emergency for one major piece of equipment or process unit: scf/min	
40. Maximum rate during emergency for one major piece of equipment or process unit: BTU/min	
41. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification):	
42. Describe the collection material disposal system:	
43. Have you included ***Flare Control Device*** in the Emissions Points Data Summary Sheet?	

44. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING:	RECORDKEEPING:
Presence of pilot (temperature)	
REPORTING: None	**TESTING:** None

MONITORING:	Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

45. Manufacturer's Guaranteed Capture Efficiency for each air pollutant.
VOC – 98%
HAP – 98%

46. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
VOC – 98%
HAP – 98%

47. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

Attachment M
Air Pollution Control Device Sheet
(FLARE SYSTEM)

Control Device ID No. (must match Emission Units Table): CMB-2

Equipment Information

1. Manufacturer: Envirotherm Model No. TVO-36	2. Method: ☐ Elevated flare ☐ Ground flare ☒ Other Describe Combustor
3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
4. Method of system used: ☐ Steam-assisted ☐ Air-assisted ☐ Pressure-assisted ☒ Non-assisted	
5. Maximum capacity of flare: scf/min 2,850 scf/hr	6. Dimensions of stack: Diameter 3 ft. Height 20 ft.
7. Estimated combustion efficiency: (Waste gas destruction efficiency) Estimated: 98 % Minimum guaranteed: 98 %	8. Fuel used in burners: ☒ Natural Gas ☐ Fuel Oil, Number ☐ Other, Specify:
9. Number of burners: Rating: 6 MMBTU/hr	11. Describe method of controlling flame: A thermocouple is present
10. Will preheat be used? ☐ Yes ☒ No	
12. Flare height: 20 ft	14. Natural gas flow rate to flare pilot flame per pilot light: scf/min ~100 scf/hr
13. Flare tip inside diameter: ft	
15. Number of pilot lights: Total 0.13 BTU/hr	16. Will automatic re-ignition be used? ☒ Yes ☐ No
17. If automatic re-ignition will be used, describe the method: Electrical restart	
18. Is pilot flame equipped with a monitor? ☒ Yes ☐ No If yes, what type? ☒ Thermocouple ☐ Infra-Red ☐ Ultra Violet ☐ Camera with monitoring control room ☐ Other, Describe:	
19. Hours of unit operation per year: 8760	

Steam Injection

20. Will steam injection be used? ☐ Yes ☒ No	21. Steam pressure PSIG Minimum Expected: Design Maximum:
22. Total Steam flow rate: LB/hr	23. Temperature: °F
24. Velocity ft/sec	25. Number of jet streams
26. Diameter of steam jets: in	27. Design basis for steam injected: LB steam/LB hydrocarbon
28. How will steam flow be controlled if steam injection is used?	

Characteristics of the Waste Gas Stream to be Burned

29.

Name	Quantity Grains of H_2S/100 ft^3	Quantity (LB/hr, ft^3/hr, etc)	Source of Material
See attached emissions calculations			

30. Estimate total combustible to flare: LB/hr
(Maximum mass flow rate of waste gas) scfm

31. Estimated total flow rate to flare including materials to be burned, carrier gases, auxiliary fuel, etc.:

32. Give composition of carrier gases:

33. Temperature of emission stream: >70 °F Heating value of emission stream: Variable (off gas from dehydrator) BTU/ft^3 Mean molecular weight of emission stream: MW = Variable (off gas from dehydrator)	34. Identify and describe all auxiliary fuels to be burned. BTU/scf BTU/scf BTU/scf BTU/scf BTU/scf
35. Temperature of flare gas: °F	36. Flare gas flow rate: scf/min
37. Flare gas heat content: ~1000 BTU/ft^3	38. Flare gas exit velocity: 8.3 scf/min

39. Maximum rate during emergency for one major piece of equipment or process unit: scf/min

40. Maximum rate during emergency for one major piece of equipment or process unit: BTU/min

41. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification):

42. Describe the collection material disposal system:

43. Have you included ***Flare Control Device*** in the Emissions Points Data Summary Sheet?

44. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING:	RECORDKEEPING:
Presence of pilot (temperature)	
REPORTING:	**TESTING:**
None	None

MONITORING: Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment or air control device.
RECORDKEEPING: Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING: Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING: Please describe any proposed emissions testing for this process equipment on air pollution control device.

45. Manufacturer's Guaranteed Capture Efficiency for each air pollutant.
VOC – 98%
HAP – 98%

46. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
VOC – 98%
HAP – 98%

47. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

ZEECO, INC.

CLIENT:	CNX Gas	DOCUMENT NO:	20602-8120
PROJECT:	Flare System	PAGES:	128 + Cover
CLIENT P.O. #:	4501033736	ZEECO SO:	20602

FLARE SYSTEM

Installation, Operation and Maintenance Manual 20602-8120

REV	DATE	BY	APP	DESCRIPTION
0	09/18/12	KNM	TSL	For Approval

Series MJ Flare Tips with Series HSLF Pilots, Series HEIC/LMM Ignition System, and Series LS Liquid Seal Drum

Installation, Operation and Maintenance Manual

S.O.20602

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ZEECO

Contents

1 INTRODUCTION

This manual covers the installation, operation, and maintenance of one flare system, comprised of one (1) Series MJ flare tip, flare stack and accessories. The equipment in this manual includes:

- Zeeco Series MJ-12 Sonic Flare Tip
- (2) Zeeco Series HSLF-Z-HEI-T/C pilot assemblies
- Zeeco Series LMM/HEIC-2 Ignition System
- Junction Box for thermocouple & HEI wiring at the base of the flare stack
- Flare stack with Liquid Seal Drum

2 EQUIPMENT DESCRIPTION

2.1 Series MJ Flare Tip

2.1.1 Description

The Zeeco Series MJ Flare tip is a multi-jet flare tip designed to dispose of a high pressure flammable waste gas stream during normal or emergency plant operations. The unique design of the flare gas exit nozzle and placement of high efficiency flare pilots ensure ignition of the flare gas and flame stability at high exit velocities.

2.1.2 Features and Nomenclature

Model MJS - Steam-assisted operation: This model includes an upper steam-assist ring assembly.

Model MJC – Steam-assisted operation: This model includes center steam assist.

Model MJGA – Gas assisted operation for smoke suppression.

Model MJPA – Water assisted operation for smoke suppression.

Model MJPC – Water curtain for radiation shielding.

The provided Zeeco Model MJ Flare Tip includes the following features:

- Spider tip(s)
- Velocity seal for purge gas reduction

2.1.3 System Options

The Model MJ Flare Tip may also be equipped with any of the following optional features:

- One or more steam injection rings for smoke suppression
- One or more gas injection rings for smoke suppression
- Water injection ring for radiation shielding and smoke suppression
- Burnback thermocouple for detection of internal burning within the flare tip assembly
- Optical monitors for flame verification, smoke or radiation monitoring
- Equipment and design for protection against lightning

2.2 Series HSLF Flare Pilot

2.2.1 Description

The HSLF flare pilot is designed for the safe and reliable ignition of flare gases or liquids exiting a flare tip. This versatile pilot design can be used with the complete line of Zeeco flare tips as well as with those of other flare manufacturers. The HSLF pilot is suitable for extreme operating environments in both on and off-shore locations.

The basic components common to all HSLF pilot assemblies are as illustrated in Figure 1. Please refer to the job specific pilot assembly drawing included in the Zeeco Project Drawings Appendix in Section 10 for details on optional equipment included.

2.2.2 Features and Nomenclature

The Zeeco Series HSLF Flare Pilot is customized to meet the unique requirements of the ignition system with which it is used. A summary of the most common options and the model nomenclature is provided below. Please refer to the job specific drawings and documents for the applicable coniguration and model designation.

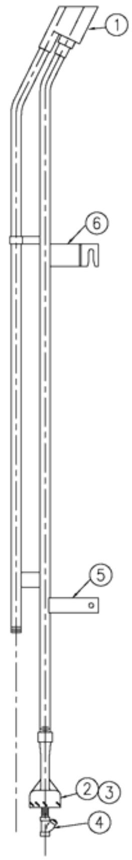
The Zeeco Series HSLF Pilot has four primary types. These are:

Model HSLF-Z – Standard pilot with FFG ignition capability.

Model HSLF-Z-HEI – Pilot with HEI ignition capability. This model may or may not include a connection for FFG ignition, depending on the system requirements.

Model HSLF-Z-SA – Pilot with self-aspirating FFG ignition capability.

Model HSLF-Z-SA-HEI – Pilot with both self-aspirating FFG and HEI ignition capability.



Item	Description
1	Pilot Tip/Shield
2	Pilot Mixer
3	Pilot Mixer Orifice Spud
4	Strainer
5	Lower Mounting Bracket
6	Upper Mounting Bracket

Figure 1: Typical HSLF Pilot Components

For the complete model name, the model designation above is followed by the number and type of thermocouples included on the pilot. If thermocouples are included on the pilot for flame monitoring, a T/C is added to the name. If there is more than one thermocouple, the T/C designation is preceded by the total number of thermocouples which may be accommodated by the pilot for flame monitoring. If dual-element thermocouples are utilized, the T/C is preceded with a D, eg. DT/C. Optionally, a RT/C may be added in place of or in addition to T/C if retractable thermocouples are included in the system. A J is prepended to indicate when either the thermocouple or HEI wiring is directly connected to a nearby junction box, eg. JHEI or JT/C.

Example 1: The complete model name of a Series HSLF Pilot with one fixed and one retractable thermocouple would be: HSLF-Z-RT/C-T/C

Example 2: The complete model name of a Series HSLF Pilot with HEI ignition, and two fixed thermocouples each with dual-elements would be: HSLF-Z-HEI-2DT/C

The Zeeco HSLF pilot has been designed to perform reliably under the most rigorous operating conditions. Investment cast components and the absence of weld seams in the heat affected zone ensure a longer service life due to increased ability to resist the effects of high heat and flame impingement. The pilot is designed to withstand high wind and rain density in both horizontal and vertical firing positions without loss of flame. Specific features include:

- 310 SS investment cast pilot tip/shield assembly inclusive of two (2) integral thermowells and integral Flame Front Generator (FFG) connection.
- Type 310 SS, investment cast pre-mix tip assembly with multiple discharge ports and stability ports.
- Investment cast flare tip mounting brackets.
- Investment cast mixer assembly. The mixer assembly is type 316L stainless steel with integral windshield and internal venturi throat.
- Pilot mixer and tip are matched to function over a wide range of fuel gas compositions. The HSLF pilot has been designed and tested on gas mixtures ranging from 100% propane to 75% hydrogen. Excellent stability and ease of ignition has been proven over this range. The pilot fuel gas can be changed from grade level. The HSLF pilot can be designed to operate reliably on Propane, Hydrogen or Refinery Fuel Gases with no adjustment to pilot gas pressure or adjustment on the pilot itself.
- The HSLF self-inspirating mixer does not have an air adjustment door and does not require any adjustment to optimize the amount of inspirated air.
- The HSLF pilot has been tested on various fuels for stability, ignition, and re-ignition in winds of 125 mph (55 m/s, 200 kph) combined with a 6 inch per hour rainfall. This testing was done with the pilot in both vertical and horizontal mounting positions. The HSLF pilot was proven to ignite, re-ignite and remain stable under all tested conditions.
- A stainless steel “Y” type strainer is provided at the inlet to the mixer assembly to prevent plugging of the mixer orifice during operation.
- Pilot heat release is nominally 65,000 Btu/hr (68,600 KJ/hr). The heat release is optimized so that it is sufficient to ensure ignition of any flared gases while keeping utility usage to a minimum.
- Retractable thermocouple feature allows the replacement of one or more thermocouples from grade while the Flare System is on-line.
- Integral high energy direct spark ignition (HEI) connection. HEI ignition can be used in place of FFG ignition or as a back-up to FFG ignition. The Zeeco HEI system consists of a stainless steel ignition probe assembly that is mounted on the pilot and provides a spark near the pilot tip to ignite the pilot. The spark is located at a point on the pilot that is away from the high heat area and in a gas stream that provides continuous cooling and protection.
- A pilot gas manifold distributes pilot gas to all HSLF pilots on the flare tip,

- eliminating redundant utility piping.
- Installed spare thermocouples for easy change-over on thermocouple failure.
- Thermocouple Temperature Transmitters allow ganging of thermocouple signals from the pilot(s) to the control system.

2.2.3 System Options

The Series HSLF Pilot may also be equipped with any of the following optional features:

- Investment cast thermocouple mounting brackets.
- Pilot Retraction System enables replacement or maintenance of the entire pilot assembly from grade while the Flare System is on-line.
- Client specific materials
- Self-aspirating FFG ignition design eliminates the need for instrument air.
- Integral Flame Ionization connection for verification of pilot operation. The Flame Ionization detection system can be configured to issue an alarm on loss of pilot or to automatically re-ignite the pilot when flame loss is detected. Flame Ionization is typically used in conjunction with thermocouple or optical sensors, as a supplemental method of pilot flame verification.

2.3 Series HEIC Automatic High Energy Ignition System

2.3.1 Description

The Zeeco Model HEIC Automatic High Energy Ignition system is designed to provide reliable direct spark ignition of flare pilots. The HEIC system may be used in place of or in conjunction with traditional flame front generator systems. The HEIC system consists of an ignition probe located near the pilot tip, wiring and an ignition module located at grade.

The HEI ignition probe is totally enclosed within a seal-welded stainless steel, protective guide tube. The guide tube is located below the heat-affected zone of the pilot flame. Therefore, the ignition probe is never subjected to the pilot flame and is protected from direct radiation from the pilot and flare flame prolonging its service life.

Solid state circuitry designed by Zeeco and fabricated specifically for our HEIC system makes up the components in the grade-mounted control panel. The ignition control module incorporates direct current capacity discharge rather than the traditional alternating current transformer power supply, allowing placement of the ignition panel to be at a greater distance from the flare tip as compared to other electric ignition systems. The ignition probe may be located up to 1000 feet

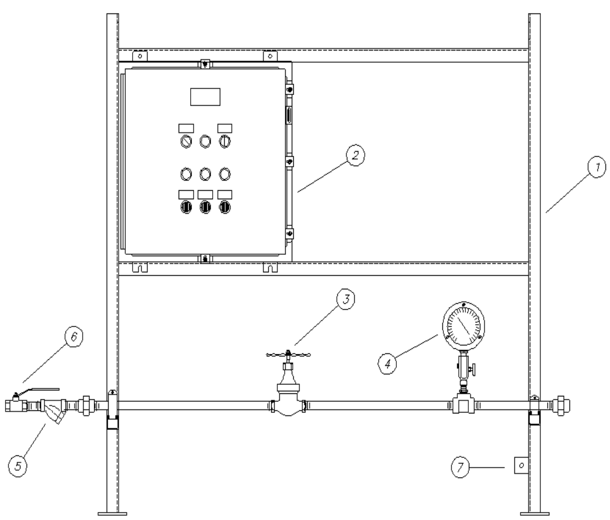
(300 meters) away from the ignition module. The connection between the ignition module and the probe at the flare pilot is typical copper wire run through conduit. No ignition fuel gas supply is required, simplifying utility piping.

The standard HEIC system includes monitoring of the pilot(s) ignition status. This is typically accomplished through the monitoring of temperature as measure by thermocouples mounted in the pilot tip. The HEIC system may also be designed to accommodate other flame monitoring devices used in place of or in addition to thermocouple.

The HEIC system is most commonly rack mounted for stand-alone installation, but may also be supplied as ship loose components for mounting by others or may be supplied for mounting to other system components or customer structures.

240 VAC power supply is the only utility requirement for an HEIC system. However, if the control panel is to be installed in a hazardous area, an instrument air supply for panel purge is required.

Pilot fuel gas piping, valves and instrumentation shall be supplied by Zeeco as part of the HEIC system. Please see the job specific documentation for the extent of the Zeeco scope of supply.



Item	Description
1	Rack
2	Control Panel
3	Pressure-Regulating
	Valve
4	Pressure Indicator
5	Strainer
	(typically by others)
6	Block Valve
	(typically by others)
7	Grounding Lug

Figure 2: HEIC Ignition System

2.3.2 Features and Nomenclature

The Zeeco Series HEI High Energy Ignition system is customized to meet the unique requirements of the combustion system I which it is utilized. A summary of the most common options and model nomenclature is provided below. Please refer to the job specific drawings and documents for the applicable configuration and model designation.

The Zeeco Series HEI System has two primary types - these are:

Model HEIM – Manually operated system. All operation takes place at the HEI local control panel.

Model HEIC – Manual or automatic operation. Automatic capabilities vary from automatic pilot relight upon flame verification failure to the capability to monitor all functions and control all operations from a remote location.

For the complete model name, the HEIM or HEIC designation is followed by the number of pilots which the system is designed to ignite. If thermocouples are included in the HEI system for flame monitoring, a T/S is added to the name. The T/S designation is preceded by the total number of temperature switches utilized for flame monitoring. Optionally, an OM may be added in place of or in addition to T/S if optical monitors are incorporated into the system. Other designations may be added to the model name if other types of flame monitoring are used.

Example 1: The complete model name of a manual HEI with the capability of igniting 1 pilot and monitoring that pilot with one thermocouple would be: HEI-1-T/S

Example 2: The complete model name of a manual/automatic HEI with the capability of igniting 3 pilots and monitoring each pilot with dual thermocouples each one connected to a temperature switch would be: HEI-3-6T/S

The provided Zeeco Model HEIC ignition system includes the following features:

- Manual or Automatic Operation
- A dedicated local Control Panel with pilot flame failure indicator lamps
- A Backup Fuel Gas System is provided. If a drop in primary fuel gas pressure is detected, the system should be manually switched to the Backup Fuel System.
- Control Panel rainshield/sunshield
- Mounting distance >1000 feet (305 m) but not >5000 ft. (1524 m) (using the appropriate gauge wire)
- Remote monitoring of flame and/or system status
- Client specific materials

- Pushbutton for testing of control panel lamps

2.4 Series LMM Flame Front Generator

2.4.1 Description

The Zeeco Model LMM Manual Flame Front Generator System is designed to provide reliable ignition and flame monitoring for combustion system pilots. The flame front generator, or FFG as it is commonly referred to, has been widely employed in combustion systems for many years. The reliability of the FFG system and the fact that the components requiring routine maintenance may be installed at significant distances from the ignition point have made it the most common type of flare ignition system. The components of the FFG system that require routine maintenance may be mounted at distances of 1000 feet (305 meters) from the ignition point for a standard system. Mounting distances of up to 5000 feet (1524 meters) are possible but require special design consideration.

The FFG system is available in a variety of configurations. The component of the FFG that is common to all systems is the Zeeco proprietary ignition chamber assembly. The ignition chamber assembly is designed to blend regulated fuel gas and compressed air in the correct proportions such that a combustible fuel/air mixture is supplied to the ignition piping. The ignition piping includes all piping located between the ignition chamber exit and the ignition point on the pilot tip. Ignition of the fuel/air mixture is accomplished inside the ignition chamber via spark generation. The ignition spark is typically electrically generated, but may be mechanically generated if electricity is unavailable (optional piezo-electric ignitor is required). Upon successful ignition inside the ignition chamber assembly, a flame front travels along the selected ignition pipe, burning the fuel/air mixture as it goes. It exits from the ignition tube at the pilot, lighting the pilot gas for the selected pilot.

It should be noted that a single ignition chamber assembly is common to all pilots being ignited by a given FFG. The FFG system is designed to ignite the selected pilot only and will not ignite all pilots simultaneously.

IMPORTANT: IN ORDER TO ENSURE PROPER FLAME PROPAGATION THROUGH THE IGNITION PIPING, ALL PIPING BETWEEN THE EXIT OF THE IGNITION CHAMBER AND THE PILOT TIP MUST BE 1" AND MUST BE SCHEDULE 40.

The standard FFG system includes monitoring of the pilot(s) ignition status. This is typically accomplished through the monitoring of temperature as measured by thermocouples mounted in the pilot tip. The LMM system may also be designed to accommodate other flame monitoring devices used in place of or in addition to thermocouples.

The LMM system is most commonly rack mounted for stand-alone installation, but may also be supplied as ship loose components for mounting by others or may be supplied for mounting to other system components or customer structures.

A fuel gas supply at a minimum of 15 psig (1.05 Kg/*cm2*g, 1.03 barg) and clean, dry compressed air (typically instrument air) at a minimum of 15 psig (1.05 Kg/*cm2*g, 1.03 barg) are required for the application of an FFG system. The fuel gas is typically natural gas, but may also be LPG, refinery fuel gas or other plant gases with sufficient LHV. LPG bottles may be incorporated into the system as a backup fuel source for the pilots and ignition system. Special consideration in the FFG design is required in this instance.

As a minimum, Zeeco recommends the following instrumentation and control components immediately upstream of the ignition chamber:

Fuel Gas Line:
Strainer
Pressure regulator or globe valve
Pressure indicator
Check valve

Compressed Air Line:
Strainer
Pressure regulator or globe valve
Pressure indicator
Check valve

Components to regulate and control fuel gas to the pilots are also commonly included with an FFG system. A strainer, fuel gas regulator or globe valve and pressure indicator are recommended as minimum.

Piping, valves and instrumentation may be supplied by Zeeco as part of the FFG system or may be supplied by the client. Please see the job specific documentation for the extent of the Zeeco scope of supply.

2.42 Features and Nomenclature

The Zeeco Model LM Flame Front Generator (FFG) System is customized to meet the unique requirements of the combustion system in which it is utilized. A summary of the most common options and the model nomenclature is provided below. Please refer to the job specific drawings and documents for the applicable configuration and model designation.

The Zeeco Model LM FFG System has two primary types. These are:

Model LMM – Manually operated system. All operation takes place at the LM local control panel.

Model LMC – Manual or automatic operation. Automatic capabilities vary from automatic pilot relight upon flame verification failure to the capability to monitor all functions and control all operations from a remote location. For the complete model name, the LMM or LMC designation is followed by the number of pilots which the system is designed to ignite. If thermocouples are included in the FFG system for flame monitoring, a T/S is added to the name. The T/S designation is preceded by the total number of temperature switches utilized for flame monitoring. Optionally, an OM may be added in place of or in addition to T/S if optical monitors are incorporated into the system. Other designations may be added to the model name if other types of flame monitoring are used.

Example 1: The complete model name of a manual FFG with the capability of igniting one pilot and monitoring that pilot with one thermocouple would be: LMM-1-T/S

Example 2: The complete model name of a manual/automatic FFG with the capability of igniting 3 pilots and monitoring each pilot with dual thermocouples each one connected to a temperature switch would be: LMC-3-6T/S

2.43 System Options

The Model LMM Ignition System may also be equipped with any of the following optional features:

- Control panel rainshield/sunshield
- External lighting
- Backup LPG bottles
- Alarm to indicate operation on backup LPG fuel gas
- Remote monitoring of flame and/or system status
- Optical monitors
- Alarms for power, pilot, and/or thermocouple failure
- Client specific materials
- Alarms to indicate low pilot fuel gas and/or backup LPG fuel gas pressure
- Remote system operation
- Inlet block valves
- Regulator bypass valves
- Piezo-electric spark generator
- Mounting distance >1000 feet (305 m) but not >5000 ft (1524 m)
- Pushbutton for testing of control panel lamps
- Lamps for indication of valve status
- Control panel Z-Purge System
- Alarm for panel purge failure
- Common alarm to indicate operator and/or maintenance required

- Control panel heater for prevention of condensation

2.5 Purge Gas System

Purge gas serves two basic purposes. The primary purpose is to provide for the safety of the Flare and your process. Safe operation of the Flare System is of primary importance, and a functional, properly-designed purge gas system is integral to ensuring safe operating conditions exist within the Flare System. The secondary purpose of purge gas is to promote long service life and reliability of the Flare System by eliminating premature burning within the Flare tip itself. Purge gas is any gas that does not contain oxygen and does not condense at ambient jobsite temperatures, typically natural gas, propane, nitrogen, or carbon dioxide. Continuous purge gas is typically injected into the Flare header near the processing facility, in order to sweep the complete Flare System and ensure no oxygen exists in the system. Please see the Purge System Operation in Section 5.1 for more information on suitable purge gases.

2.5.1 Typical Purge Gas Usage

It is required to continuously purge Flare Systems for refineries, chemical plants, gas production plants, and most offshore platforms, in order to prevent the ingress of Oxygen into the system through the Flare Tip(s) when the system is not flaring. It is also required to purge all headers leading into the Flare System prior to start-up. For applications where purge gas is not available, such as for remote pipeline Flares and loading terminals, use of flame arrestors or liquid seal drums in the Flare header for protection of the Flare header and plant is typical. In addition, the entire stack would need special design consideration to consider eliminating purge gas usage. For some systems where purge gas combustion or emission is not preferred, a Flare gas recovery system is commonly used in conjunction with some type of valve or relief device that is normally closed to the Flare, which opens when the capacity of the Flare gas recovery system is exceeded.

A standard purge gas system consists of a reliable purge gas source and suitable controls to maintain the flow of purge gas to the Flare and Flare header. It is typically recommended to inject purge gas into a Flare System at a point in the header farthest from the Flare stack. This allows the purge gas to ”sweep” the entire Flare header system and to disturb or mix any stagnant points in the system that may contain trapped air or oxygen. Typical controls for the injection of continuous purge gas include an upstream strainer or filter to ensure clean gas, a pressure regulator to control the upstream pressure of the orifice, a restriction orifice sized for the proper minimum flow of purge gas, some type of pressure sensor and switch to alarm on the loss of pressure upstream of the orifice, and a manual bypass to ensure purge gas flow in the event the regulator or orifice require maintenance.

Purge gas is any gas that does not contain oxygen, and will not reach dew point under normal ambient conditions. Typical purge gases are natural gas, nitrogen, propane, and carbon dioxide. The use of a gas that is heavier than air can significantly reduce the amount of purge required by the system. Please see the Utility Requirements Appendix in Section 11 and the Zeeco Flare Tip and Gas Seal Assembly drawings for required purge gas rates.

2.5.2 Purge Gas Reduction

The purge gas rate is determined both by the Flare tip design and by any purge gas reduction device that may be installed in the Flare System. There are several purge gas reduction devices available, but basically only two (2) generic types:

Diffusion Type Device – The lowest purge rate is achieved using a diffusion type seal device, commonly called a Molecular Seal, Gas Seal, Buoyancy Seal, Labyrinth Seal, or

Density Seal. This type of purge gas reduction device actually forms a molecular barrier to limit air entering the Flare stack. The common purge gas rate for a diffusion type device is approximately 0.01 feet per second velocity, based on the nominal Gas Seal size. The diffusion type seal device is typically large, mounts at the top of the stack, increases the wind loading on the stack, requires installation of a dedicated drain line, and has a high capital cost. This type device requires a dedicated drain line to grade to ensure liquids are not trapped in the body of the seal device. The diffusion type device does, however, provide for the lowest possible purge gas rate of any purge gas reduction system for protection of a given Flare header. In addition, the diffusion type seal also protects the stack even if purge gas flow is interrupted for any reason. The diffusion type seal is the best choice if the gas you are flaring has a very high flame speed (eg. Hydrogen, Carbon Disulfide, etc.), if the purge gas system is not very reliable at your jobsite, or if the cost of purge gas is very high. A diffusion type seal with purge gas rate of 0.01 ft/sec will maintain an oxygen level in the stack below the seal of less than 0.5%. For this reason, the diffusion type seal is also the safest possible purge reduction device available.

Velocity Seal – The other major type of purge gas reduction device is the Velocity Seal. This device consists of a cone or multiple cones, installed in the Flare tip itself. The velocity seal type device requires a purge rate 4 times higher than that of the diffusion type device. This device will not protect the Flare stack if purge gas flow is interrupted. Velocity type seals are known in the industry by trademark names such as Fluidic Seal, Diodic Seal, and Airrestor Seal. A velocity type seal device, properly purged, will ensure a maximum oxygen level in the stack below the seal of 4-5%. This level is very safe for hydrocarbon gas flaring systems.

Purge gas rates noted above are based on the use of Natural Gas. If a gas heavier than air such as Nitrogen or Carbon Dioxide is used, these purge gas rates can be reduced. Please see the Utility Requirements Appendix in Section 11 and the Zeeco job specific Flare Tip and Gas Seal Assembly drawings for required purge gas rates.

2.5.3 Purge Gas Elimination

Note that the devices listed above are both purge gas **reduction** devices, and not devices to **eliminate** purge gas. If elimination of purge gas is desired, some type of flashback protection must be provided in the line to the Flare. This can either be in the form of a detonation flame arrestor device that bolts into the pipeline, or a liquid seal drum that is designed to act as a flame arrestor. If one of these devices is installed in the Flare header near the base of the Flare stack, it is possible to eliminate the purge gas for the Flare.

Any flame front or flashback that may occur in the Flare stack starting at the Flare tip would be stopped by the flame arrestor or liquid seal drum and would not travel back to the processing facility. Note that the Flare System and stack downstream of the liquid seal or flame arrestor device would also need to be designed to contain an internal deflagration (pressure wave explosion). One limitation is that the largest flame arrestor device available for Flare type service is approximately 36 inch in line size.

2.5.4 Eliminating Internal Burning

Besides ensuring the safety of the Flare System, the secondary purpose of purge gas is to promote long life and reliability of the Flare tip by eliminating internal burning in the Flare tip assembly, in the case of a Flare System that is using a combustible purge gas. If the purge gas is not combustible, internal burning is not a concern. This is used mainly for offshore Flare applications where there is high wind and the wind can force the gases to burn inside the Flare tip. In these situations, the purge gas rate must be very high, about 1.0 ft per second velocity, to ensure the flame burns **outside** of the top of the Flare tip rather than inside the Flare tip assembly. The Flare System must be thoroughly analyzed to determine whether this situation may exist in a given Flare application.

2.5.5 Flare Gas Temperature

If the Flare System is designed to handle Flare gas relief cases that are hot (typically over 350_ Fahrenheit (175_ Celsius)), the designer needs to consider whether some type of supplemental purge gas injection system is necessary. Supplemental purge gas injection controls (Zeeco Tempspurge) may be required to ensure the safety of the total system.

When hot gases are venting into the Flare header system, the entire volume of the Flare header, including the stack and associated drums, will fill with this hot gas. When the flaring event stops, the Flare header system will still be filled with this hot gas, and the velocity in the system will reduce to essentially zero. At this point, depending on the Flare header system total volume and surface area, the gases in the system will begin to cool. If the ambient conditions are cold, and there is a wind or rain present, the heat transfer rate (cooling of the gas in the header system) will be very rapid. Heavy Flare gases can easily condense to liquids. The Flare header system will act as a large heat exchanger, and the gases will shrink, condense, and reduce quickly in total volume.

If there is no further relief of gases into the Flare header system from the process, the only point of entry in to the Flare System is via the Flare tip. As the gases in the system shrink, the change in volume can only be recovered by air entering the Flare tip. The shrinkage of the gas in the header system will rapidly pull air into the Flare tip, Flare stack, and the Flare header system. This can easily create a combustible mixture in the Flare header / stack, causing a dangerous situation for the facility.

Each Flare System must be analyzed in detail to determine whether this condition can
exist. Instrumentation can be supplied to eliminate this problem. Zeeco can provide a
system called Tempspurge to provide for supplemental purge gas during this situation.

The Tempspurge system consists of a pressure sensor mounted to the Flare header, a temperature sensor mounted to the Flare header, and a purge gas injection valve. If the pressure in the Flare header is low, indicating **no** Flare gas flow, and the temperature in the Flare gas header is high, indicating a hot Flare gas relief has occurred, the Tempspurge control logic will open a supplemental purge gas injection valve that will supply additional purge gas into the header system. The flow rate of this gas is determined during the detailed analysis of the Flare header system volume and surface area, and is set by the worst case shrinkage rate possible considering the highest relief gas temperatures, and the coldest ambient conditions with rain. The supplemental purge gas is injected into the Flare header at a point near the midpoint of the total volume of the system, to provide the most reliable elimination of shrinkage of total volume. This supplemental purge gas injection continues until either the temperature of the gases in the header reduce, or the pressure in the header increases. The specific set points for each Tempspurge system are unique to the Flare System. Please refer to job specific documentation for further information.

2.6 Flare Stack

Please see the Introduction in Section 1 for Flare Stack description and information on included components.

2.6.1 Series LS Liquid Seal Drum

The Flare System is provided with a standalone Liquid Seal Drum. The Zeeco Series LS Liquid Seal is designed to provide a liquid barrier between the flare stack and the flare gas header. This liquid barrier acts as a flame arrestor and oxygen barrier, preventing oxygen from migrating into the flare system through the flare tip and flare stack, and, in case of a flashback, preventing the flame front from entering the flare gas header. With the use of a Series LS Liquid Seal Drum in a suitably designed system, it is possible to eliminate the need for purge gas completely. Any flame front or flashback that may occur in the flare stack starting at the flare tip would be stopped by the liquid seal drum and would not travel back to the processing facility. To make use of this feature of the Zeeco

Model LS Liquid Seal, the flare system and stack downstream of the liquid seal must have been designed to contain an internal deflagration (pressure wave explosion).

The liquid level in the seal is set to allow low flare gas flow rates to pass through continuously in small pockets, preventing the unimpeded flow of flare gas and preventing reverse migration of gas through the Liquid Seal. At high flare gas rates, in case of emergency, the liquid in the drum is displaced allowing free flow of gas. The liquid seal vessel is equipped with a continuous water makeup nozzle to replace water as required, with an overflow outlet to prevent overfilling and with a separate skimmer outlet to enable skimming the surface of undesirable liquids. Ladders and platforms are provided for accessing the level bridles and other nozzles.

3 PRE INSTALLATION

3.1 Storage

When practical, all items have been placed into a crate that should protect the equipment during a seagoing trip. All equipment has been secured in place to prevent movement during transportation, offloading, and loading. Flanges have been protected with both wood covers and with a preservative applied to those flanges. Loose conduit has been affixed to a pallet and the ends of the equipment have been covered for protection. All other miscellaneous equipment has been crated for shipment and storage. It is highly recommended that at the time of receipt a careful account be made of all equipment. When opening the crates, be careful not to damage the crates so that you may reuse them for storage purposes until you are ready to install the equipment. This practice should help ensure against the loss of any equipment. Thus, Zeeco highly recommends utilizing the crates for storage purposes.

3.2 Shipping and Handling

Sling and Center of Gravity marks have been applied to all packages in excess of 500lb (227 kg). Be sure to keep boxes in the upright position during loading, offloading, transportation, and storage. Crates have been marked with Up Arrows. Up Arrows signify that the top of the crate should not be used to lift or store the crate on. Crates have forklift access for your convenience. This is the preferred method of Handling. If a forklift is not available then a crane with straps can be used. Remember to always keep the up arrow pointed towards the sky.

3.3 Installation Checklist

Read this operating manual and review the Zeeco drawings thoroughly before beginning any assembly or operational procedures of this equipment. A packing list is supplied with the delivery of the equipment. Equipment received should be checked against this list and confirmed to be correct immediately upon receipt at the jobsite. Thoroughly check all equipment for any damage that might have occurred during shipment. Prior to any lift the installation crew should formulize and verify their lift plan. Check all structural, piping, and electrical connections throughout the flare system. Ensure that all bolted and threaded connections are tight, and that all connections are properly made before proceeding with commissioning of the flare system.

3.4 Foundation Check

Prior to installation of any equipment, the following items relating to the foundation should be checked as a minimum:

- Dimensions, shape and location of the foundation.
- Cleanliness of the foundation surfaces. Any scrap metals, concrete blocks and other obstacles shall not be laid on the foundation surfaces.
- The foundation has a level surface.
- The correct orientation of the foundation.

4 INSTALLATION

WARNING!

THE ZEECO SUPPLIED SYSTEM CONTAINS COMPONENTS AND PARTS WITH SMALL PORTS OR PASSAGES THAT CAN BE EASILY PLUGGED. IT IS MANDATORY AND CRITICAL TO PROPER OPERATION AND EQUIPMENT LIFE THAT ALL FEED LINES AND PIPING BE BLOWN OUT AND FREE OF SCALE, DEBRIS, TRASH, LIQUIDS, ETC.

4.1 Flare Stack

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE INSTALLATION OF THE FLARE STACK. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY INSTALLATION OF OR REPAIR TO THE FLARE STACK.

Refer to the job specific drawings for details on erection of the Flare Stack. Assemble and erect the Flare Stack per the job specific drawings.

All aspects of the Flare Stack installation should be governed by the field erection crew. The field erection crew should review the project drawings and familiarize themselves with the local safety procedures and regulations governing this installation.

All aspects of the erection of the Flare Stack are therefore up to the field installation contractor’s experience to decide how to safely and efficiently erect the Flare Stack. At a minimum, the following steps should be performed:

1. Install ladder and platform (if applicable) to the flare stack as indicated on the project drawings.

2. Install any thermocouple junction box(es) to the Flare Stack as indicated in the Zeeco project drawings

3. Install any thermocouple conduit to the flare stack per the job specific drawings. Ensure that any “fixed” type mounting brackets hold the conduit securely and that any ”slide” type attachments allow the conduit to expand and contract freely. Feed wiring through the conduit and terminate in junction box at the base of the Flare Stack. The wire insulation is susceptible to abrasion damage so care should be taken when pulling the wire through conduit. Do not attempt to pull wire through 90_bends. If both Standard and High Temperature thermocouple wire are provided, be sure to reserve the High Temperature wire for use on the flare stack. If necessary, provide strain relief at pull box(es) as indicated in the job-specific drawings.

4. Install any pilot fuel, FFG ignition, drain and air piping to the flare stack per the job specific drawings. Ensure that any “fixed” type mounting brackets hold the piping securely and that any ”slide” type attachments allow the piping to expand and contract freely.

5. Make ground connection(s) at grounding lug(s). Ensure bare metal-to-metal contact at lug for true electrical connection.

6. Apply touch-up paint to any exposed, painted sections of the Flare Stack as required.

4.1.1 Series LS Liquid Seal Drum

1. Install the vessel onto foundation and secure to foundation, making sure that the Liquid Seal has been properly oriented in relation to flare system inlet and outlet lines. See job specific drawings for layout.
2. Check unit for damage paying close attention to the nozzles and bracketing for the ladders and platforms.
3. Install the platforms.
4. Install the ladders to the platforming.
5. Make ground connection(s) at grounding lug(s). Ensure bare metal-to-metal contact at lug for true electrical connection.
6. Install all instrumentation to the drum. See job specific drawings for type and location of instrumentation.

7. Connect a suitable loop seal to Skimmer/Overflow outlet as indicated in Zeeco drawings. Ensure that the loop is of proper height and that the top of the loop seal is at or below the Normal Liquid Level (NLL).

Interconnection with Flare System

1. Connect Liquid Seal to flare system lines. Refer to job specific drawings for information on line connections.
2. Make remaining connections for liquid fill, overflow, and drain, installing gasketing as necessary. See job specific drawings for type and location of utility connections.
3. Blind all unused connections. See job specific drawings for type and location of utility connections. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange.

4.2 Series MJ Flare Tip

Your flare tip is supplied with lifting lugs. Flare Tip lifting lugs are only intended to be used during the FIRST LIFT of the Flare Tip. It is recommended they be removed or disabled after installation. After a Flare has been placed into service the lugs are in a heat-affected zone, and thus subject to thermal damage. Using the lugs for subsequent lifts is purely at the liability of others and not Zeeco. If the lugs are to be used for subsequent lifts, they should be thoroughly inspected by a qualified inspector and have had a dye penetrant test conducted on 100% of the welds of the lugs to the Flare Tip shell. Flare Tip lifting lugs may have been designed for vertical lifting only. Do not lift from horizontal without ensuring that lifting lugs are suitable for horizontal lifts.

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE INSTALLATION OF THE FLARE TIP. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY INSTALLATION OF OR REPAIR TO THE FLARE TIP.

WARNING!

THIS PROCEDURE IS PRESENTED AS A GUIDE ONLY. THE EXACT PROCEDURE FOR YOUR JOBSITE IS A FUNCTION OF

THE EQUIPMENT AVAILABLE, AND THE TRAINING AND ABILITIES OF THE PERSONNEL PERFORMING THE PROCEDURE. ZEECO RECOMMENDS THAT TRAINED AND EXPERIENCED RIGGING PERSONNEL BE USED. PRIOR TO ANY LIFT, A THOROUGH PLAN SHOULD BE DRAWN UP AND APPROVED BY THE APPROPRIATE SITE SAFETY PERSONNEL. THIS PROCEDURE IS ONLY A GENERAL GUIDE.

4.2.1 Installation of Series MJ Flare Tip

1. The Flare System has been designed for the Flare Tip to be installed only **after** the Flare Stack has been erected.
2. For an elevated flare, the HSLF pilots may be mounted to the Flare Tip and lifted into place along with the Flare Tip , or may be attached after the Flare Tip is in place. See HSLF pilot installation procedures in Section 4.2 for details.
3. Use spreader bars when possible for all Flare Tip lifts.
4. Attach Flare Tip to the Flare Stack. Ensure Flare Tip is properly aligned as shown on the Zeeco drawings. It is crucial that the Flare Tip be properly oriented so that the pilot location is adjacent to a flare gas exit. See job specific drawings for connection type and details.

4.2.2 Interconnection with Flare System

Continue with pilot installation and/or interconnection in the flare pilot installation section.

4.3 Series HSLF Flare Pilot

4.3.1 Installation of HSLF Pilot

1. To prevent damage the pilot should be stored in its packing materials until it is ready to be mounted on the flare tip.
2. Unpack the pilot assembly when ready to install onto the flare tip.
3. Inspect the pilot against the job specific pilot drawings for any shipping damage. If damage is discovered, consult a Zeeco service professional.
4. Locate the upper mounting bracket on the pilot and the corresponding mounting bracket on the flare tip. If there is no corresponding mounting bracket on the flare tip, consult a Zeeco service professional.
5. Make sure each thermocouple is fully inserted into the thermowell on the pilot tip.

WARNING!

IT IS CRUCIAL THAT THE PILOT MOUNTING BRACKETS ON THE FLARE TIP BE PROPERLY LOCATED. IF THE BRACKETS ARE INCORRECTLY LOCATED, PREMATURE PILOT FAILURE OR THE INABILITY OF THE PILOT TO LIGHT THE FLARED STREAMS MAY RESULT. THE RESULTING UNBURNED FLARE RELEASE COULD RESULT IN SERIOUS INJURY OR DEATH. WHEN IN- STALLING THE PILOT ONTO MOUNTING BRACKETS NOT SUPPLIED AND LOCATED BY ZEECO, CONSULT THE JOB SPECIFIC DRAWINGS TO DETERMINE PROPER BRACKET LOCATION.

6. To secure the upper mounting bracket, slide the grooves of the upper pilot bracket over the arms of the upper mounting bracket on the Flare Tip.
7. With the upper mounting bracket in place, rotate the pilot assembly until the hole in the lower mounting bracket on the HSLF pilot lines up with the hole of the lower mounting bracket on the flare tip. Place a bolt through the aligned holes of both brackets and secure with two heavy hex nuts. Note: Zeeco recommends A193B Gr. 8M Bolts and A194 Gr. 8M nuts for this application. A193B Gr. 8 Bolts and A194 Gr. 8 nuts are also acceptable.

4.3.2 Interconnection with Flare System

1. Connect the pilot gas distribution manifold to the flare pilot gas line located on the runner(s). See the job specific pilot drawings for the type and size of connection included on the pilot gas manifold. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
2. Connect the pilot gas connection on the HSLF pilot to the corresponding connection on the pilot gas manifold. See the job specific pilot drawings for the type and size of connection included on the HSLF pilot. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
3. Attach any Pilot Gas mixer assemblies to Pilot gas line(s) as necessary. Ensure that Pilot mixers are located outside of the Radiation/Wind Fence for adequate ventilation. The pilot gas mixer should be oriented pointing down. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections. See the job specific Pilot drawings for the type and size of connection included on the pilot(s)

4. Connect the FFG ignition line located on the runner(s) to the ignition connection on the HSLF pilot. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. See the job specific pilot drawings for the type and size of connection included on the HSLF pilot.
5. Connect the thermocouple tubing located on the runner(s) to the corresponding connection on the HSLF pilot. See the job specific pilot drawings for the type and size of tubing connection included on the HSLF pilot.
6. Connect the HEI wiring conduit (located on the runner(s)) to the corresponding connection on the HSLF Pilot and make the termination of the HEI wire in the HEI weather-head, using the provided terminal block or ceramic wire nuts. Install the provided Heat Shield to the HEI weather-head as indicated on the project drawings. See the job specific pilot drawings for the type and size of connection included on the HSLF pilot. If both Standard and High Temperature HEI wire are provided, be sure to reserve the High Temperature wire for use on the sections closest to the flare tip See the job specific wiring diagrams for details on HEI wiring connections.

4.4 Series HEIC Ignition System

4.4.1 Installation of HEIC System

1. Mount the system rack on the appropriate foundation or structure. Refer to job specific Zeeco drawings.
2. Connect the inlet fuel gas and instrument air lines as indicated in the job specific Zeeco Drawings. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
3. Make connection from the Pilot Fuel Gas Backup System to the inlet on the Ignition System. It is recommended to install drain valves at any low points as necessary. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
4. Connect the power cable and any required customer control room wiring, including connections for remote monitoring of pilot alarm if desired. See job specific Zeeco drawings.
5. Make ground connection(s) at grounding lug(s). Ensure bare metal-to-metal contact at lug for true electrical connection.
6. Install all pressure gauges per the job specific Zeeco drawings.
7. Install other ship loose equipment (if provided) per the job specific Zeeco drawings.

4.4.2 Interconnection with Flare System

1. If pilot gas lines are included in Zeeco supply: Connect the pilot gas lines from the Ignition System to the corresponding piping connections on the flare. It is recommended to install drain valves at any low points as necessary. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
2. Make the required HEI wiring connections from the Ignition System Control Panel to the Ignition Transformer (HET) junction box at the base of the flare. If both Standard and High Temperature HEI wire are provided, be sure to reserve the High Temperature wire for use on the flare stack. See job specific wiring diagrams for details on HEI wiring connections.
3. Make the required thermocouple extension cable connections from the Ignition System Control Panel to the thermocouple junction box at the base of the flare. If both Standard and High Temperature thermocouple wire are provided, be sure to reserve the High Temperature wire for use on the flare stack. See job specific wiring diagrams for details on thermocouple wiring connections.
4. Plug all unused wiring conduit entries on control panel box.

4.5 Series LMM Flame Front Generator

4.5.1 Installation of Flame Front Generator

1. Mount the system rack on the appropriate foundation or structure. Refer to job specific Zeeco drawings.
2. Connect the inlet fuel gas and instrument air lines as indicated in the job specific Zeeco Drawings. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
3. Connect the power cable and any required customer control room wiring, including connections for remote monitoring of pilot alarm if desired. See job specific Zeeco Drawings.
4. Make ground connection(s) at grounding lug(s). Ensure bare metal-to-metal contact at lug for true electrical connection.
5. Install all pressure gauges per the job specific Zeeco Drawings.
6. Install other ship loose equipment (if provided) per the job specific Zeeco Drawings.

4.5.2 Interconnection with Flare System

1. Connect the 1 inch pilot FFG ignition lines from the Ignition System to the corresponding piping connections on the flare, including drain valves for

any low points as necessary. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.

2. If pilot gas lines are included in Zeeco supply: Connect the pilot gas lines from the Ignition System to the corresponding piping connections on the flare. It is recommended to install drain valves at any low points as necessary. Install flanged connections using suitable gaskets. Torque all bolts to ANSI recommended values for the size and type of connection flange. Apply suitable thread sealant to threaded gas connections.
3. Make the required thermocouple extension cable connections from the Ignition System Control Panel to the thermocouple junction box at the base of the flare. If both High Temperature and Low Temperature thermocouple wire are provided, be sure to reserve the High Temperature wire for use on the uppermost sections of the flare stack. See job specific wiring diagrams for details on thermocouple wiring connections.
4. Plug all unused wiring conduit entries on control panel box.

5 OPERATION

5.1 Recommended Purge Procedures

5.1.1 Introduction

There is danger of severe explosion in a Flare System if the Flare pilots are ignited before the Flare has been purged. It is important to purge the entire Flare System with a volume of non-condensable purge gas equal to ten or more times the volume of the Flare System to assure low or zero oxygen levels. The Flare System includes all piping from relief valves to the riser through the elevation of the Flare at the Flare Tip.

The pilots should be ignited only after the system is thoroughly purged, and as the purge gas is still being admitted. If the purge gas is combustible, the burning of the purge gas at the Flare will be proof of pilot ignition.

Safe operation of the Flare System requires that there be no Oxygen, and thus no air, present in the flared gases as they reach the pilots. The quantity of continuous purge gas is set to avoid entry of air into the Flare System while the Flare is in operation and the pilots are burning. Ensure that the Flare System is gas tight prior to purging. Any included loop seals must be filled with liquid to the requisite depth prior to purging the Flare System. Any manways or inspection openings to the Flare gas line must be blinded. If it is required that the Flare System be opened for any reason, extinguish the pilots before work begins and do not re-ignite them until after the system has been thoroughly purged. The Flare System must be absolutely gas tight before ignition.

5.1.2 Purge Rates and Gases

Suitable Purge Gases Any gas or mixture of gases that does not contain Oxygen and
will not reach dew point at ambient job site temperatures can be used as purge gas for the Flare System. This gas is sometimes referred to as ”sweep gas”. Suitable purge gases are natural gas, propane, butane, nitrogen, carbon dioxide or any inert gas. Steam is not recommended as a purge gas for two reasons. First, steam is at elevated temperatures and, as the steam cools and condenses, the reduction in volume will draw air back into the Flare System. Second, using steam could cause accelerated corrosion and a freezing hazard. **The quantity of**

purge gas required as indicated on the job-specific Flare Tip Assembly drawing(s) is based on the specific gas as indicated on said drawing(s). Use of any purge gas other than that indicated on the job-specific Flare Tip and Gas Seal assembly drawing(s) may require a larger flow rate to prevent ingress of Oxygen into the Flare System.

Admission Point for Purge Gas

- Start-up Purge – In all cases, the start-up purge gas must enter the header immediately downstream of the relief valve farthest from the Flare System inlet so that the purge gas will "sweep" the entire system. If there is more than one header feeding into the Flare System, each header must be purged, or there must be entry of purge gas to each header that enters the system downstream of any normally-closed relief valves. The total volume of the system is defined as the volume of all flare gas piping from the Flare tip(s) to the relief valve(s) that feed into the flare header.

- Continuous Purge – An orifice union should regulate the continuous purge gas rate. A strainer which has a mesh opening not more than one-quarter the diameter of the limiting orifice is recommended upstream of the purge gas regulator. Continuous purge gas should enter the header(s) in the same location as the Start-Up Purge gas, so that the purge gas will "sweep" the entire system.

Alarm for Purge Failure It is recommended that purge flow rate be measured and an
alarm sounded if a low flow condition is present.

Special Considerations for Multiple Flare Systems In Flare Systems containing multiple flares within close proximity to one another, one or more Flare Systems may be reserved as a backup flare. When not in use, backup flares may be completely shut down and unpurged granted special considerations are followed. Backup flares must be blinded and completely isolated from any active flare gas headers. Simply closing block valves will not suffice to prevent the ingress of flammable gas into the backup Flare System. During startup of a backup Flare System that has not been continuously purged, the backup flare must be purged with a non-flammable gas in order to prevent explosion, since there will be an ignition source at nearby flare tips. Failure to follow this procedure during startup of a Flare System that has not been continuously purged, and is in close proximity to other operating flare tips, will result in a hazardous condition and the possibility of explosion within the flare stack.

Purge Volume Required The amount of purge gas required is dependent on the type of equipment used and the operating conditions of the Flare. To prevent the migration of air into the Flare, the minimum continuous purge rate recommended in the Utility requirements Appendix in Section 11 of this manual and on the Zeeco Flare Tip and Gas Seal Assembly drawings must be maintained in the Flare riser. **The quantity of purge gas required as indicated on the job-specific Flare Tip Assembly drawing(s) is based on the specific gas as indicated on said drawing(s). Use of any purge gas other than that indicated on the job-specific Flare Tip and Gas Seal assembly drawing(s) may require a larger flow rate to prevent ingress of Oxygen into the Flare System.**

The minimum rates noted above must be held at all times when the Flare is in operation.
As previously mentioned, the purge gas flow should be metered. As the Flare gas rate increases, the purge gas rate may be decreased as long as the minimum velocity is maintained or exceeded. The system should be balanced such that the increase and decrease of the purge gas rate is automatic and there is no time when the Flare flow falls below the minimum purge rate required.

CAUTION: PURGE GAS SHOULD BE FLOWING AT ALL TIMES TO PREVENT THE POSSIBILITY OF AN EXPLOSION.

If the flared gas has an average molecular weight exceeding 30, the potential of the gas to condense must be considered when designing the purge gas system. The dew point calculation should be made and the volume of the Flare gas that will condense at the atmospheric conditions must be compensated for with purge gas so that the velocity does not fall below the minimum set point. Since dew point is temperature related and purge gas can be quite expensive, it is suggested to place the amount of purge gas required to make up for the condensing Flare gas on a temperature control system. Using a temperature control system, the additional purge gas can be automatically added when conditions require.

Start-Up

1. Begin Start-Up Purge of the entire Flare System (including flare header upstream of the flare inlet). Start-up will begin with the purging of the Flare System for ten (10) volume changes. The total volume of the system is defined as the volume of all flare gas piping from the flare tips to the relief valve(s) that feed into the flare header. This will help ensure a safe start up. Purge the Flare System with any gas that does not contain oxygen and will not reach its dew point at any time during the purging process. Convenient gases are nitrogen or natural gas. Purge until ten times the volume of the system has been replaced, then continue purge throughout start-up.

2. Begin Continuous Purge of the Flare Tip(s). Open the Purge Gas valves supplying Continuous Purge Gas to the Flare System. Set the main Purge Gas regulator or globe valve to give the Recommended Continuous Purge Rate for the Flare Tip(s). Refer to the Recommended Purge Rates in the Utility Requirements Appendix in Section 10 of this manual and on the Zeeco Flare Tip and Gas Seal Assembly drawings.

3. Continue with Start-up of Flare System.

Normal Operation

1. Continuous Purge Gas must be flowing at all times the Flare System is in Operation.

2. The amount of purge gas required is dependent on the type of equipment used and the operating conditions of the Flare. To prevent the migration of air into the Flare, the minimum continuous purge rate recommended in the Utility Requirements Appendix in Section 10 of this manual and on the Zeeco Flare Tip and Gas Seal Assembly drawings must be maintained in the Flare stack. **The quantity of purge gas required as indicated on the job-specific Flare Tip Assembly drawing(s) is based on the specific gas as indicated on said drawing(s). Use of any purge gas other than that indicated on the job-specific Flare Tip and Gas Seal assembly drawing(s) may require a larger flow rate to prevent ingress of Oxygen into the Flare System.**

3. The minimum rates noted above must be held at all times when the Flare is in operation. The purge gas flow should be metered. As the Flare gas rate increases, the purge gas rate may be decreased as long as the minimum velocity is maintained or exceeded. The system should be balanced such that the increase and decrease of the purge gas rate is

automatic and there is no time when the Flare flow falls below the minimum purge rate required.

5.2 Series LS Liquid Seal Drum

5.2.1 Pre-Commissioning

1. Confirm that all equipment is installed and assembled in accordance with all applicable drawings and with applicable industry and site specific safety specifications.
2. Confirm that all mechanical and electrical connections are properly made.
3. Confirm that all gas and steam connections are airtight and all bolts are properly torqued.
4. Confirm that all unused utility connections, vents and inspection openings are blinded and all bolts are properly torqued. Any vents that are included for the Liquid Seal skirt or support structure, and not connected to the pressure vessel or flare gas header, should be left open.
5. If level transmitters/gauges are included, fill the seal with liquid to verify correct operation of all transmitters/gauges at all liquid levels as indicated on the Zeeco drawings.
6. Be sure that the seal has been filled with liquid to the Normal Liquid Level (NLL). If transmitters/gauges are included, check to verify that you are receiving an NLL signal.

5.2.2 Startup

1. Be sure that the seal has been filled with liquid to the Normal Liquid Level (NLL). If transmitters/gauges are included, check to verify that you are receiving an NLL signal.
2. Verify that the attached loop seal is filled with liquid.
3. Be sure the entire Flare System is purged. Refer to the Recommended Purging Procedures in Section XX for additional information.
4. Continue with startup of the flare system. Refer to startup procedures in the Operation section for the flare tip being utilized.

5.2.3 Normal Operation

1. Maintain water at the Normal Liquid Level (NLL) as indicated in drawings.
2. Ensure that any attached loop seals are filled with liquid and properly functioning.

3. Ensure water is continuously flowing through the Overflow outlet.
4. Never allow seal to run dry (below the Low or Low-Low Liquid Level(s), as indicated on Zeeco drawings) during normal operation and compromise the seal. This warning does not apply to system operation during a flaring event. The Liquid Seal Drum may be designed to be evacuated of liquid by flaring events. Liquid levels should be reestablished once the flaring event has ended.
5. Liquid fill operation should be controlled to shut off the liquid fill during any flaring events. Liquid levels should be reestablished once the flaring event has ended.
6. Depending on the presence of very cold flare gas conditions, the seal may need to be completely drained of liquid immediately prior to any flaring events. Refer to the Customer Process Data Sheets Appendix in Section 9 for information on job specific design requirements. If such conditions are present, drain operation should be controlled to drain the Liquid Seal completely when a flaring event is detected.
7. In case of questions on performance of the unit, check the continuity of the system. Contact Zeeco for assistance.

5.3 Series HSLF Flare Pilot

5.3.1 Pre-Commissioning

1. Confirm that all equipment is installed and assembled in accordance with all applicable drawings and with applicable industry and site specific safety specifications.
2. Confirm that all mechanical and electrical connections are properly made.
3. Confirm that all gas connections are airtight and all bolts are properly torqued to ANSI recommended values for each connection flange. See job specific drawings for flange size(s).
4. Check that all electrical wiring is free from breaks as verified by continuity testing.
5. Ensure that electrical, FFG ignition and fuel gas connections are properly made to the HSLF pilot(s).
6. Ensure that the pilot tip is properly located in relationship to the flare tip. See job specific flare tip drawings.

5.3.2 Startup

WARNING!

VERIFY THAT THE FLARE SYSTEM HAS BEEN PROPERLY PURGED PRIOR TO INITIATING PILOT OPERATION. FAILURE TO PROPERLY PURGE THE SYSTEM MAY RESULT IN EXPLOSION. VERIFY THAT ALL FLARE PILOTS ARE IGNITED AND THAT STABLE PILOT OPERATION IS ESTABLISHED PRIOR TO INITIATING FLARE OPERATION.

For HSLF flare pilot startup please refer to startup procedures for the HEIC ignition system and follow the ignition system instructions.

5.4 Series HEIC Ignition System

5.4.1 Pre-Commissioning

1. Please refer to the Purge Operation in Section 5.1 for additional information.
2. Confirm that all equipment is installed and assembled in accordance with all applicable drawings and with applicable industry and site specific safety specifications.
3. Confirm that all mechanical and electrical connections are properly made.
4. Confirm that all fuel gas connections are airtight and all bolts are properly torqued.
5. Check that all electrical wiring is free from breaks as verified by continuity testing.
6. Ensure that electrical power and pilot fuel are properly supplied to the HEIC system rack.
7. For systems designed for installation in hazardous areas, conduit seal fittings have been provided on the conduit on the ignition rack. Once the ignition system wiring has been verified, and prior to commissioning, all conduit seal fittings must be packed with fiber as necessary, and filled with suitable sealing compound.

5.4.2 Startup

WARNING!

VERIFY THAT THE FLARE SYSTEM HAS BEEN PROPERLY PURGED PRIOR TO INITIATING PILOT OPERATION. FAILURE TO PROPERLY PURGE THE SYSTEM MAY RESULT IN EXPLOSION. VERIFY THAT ALL FLARE PILOTS ARE IGNITED AND THAT STABLE PILOT OPERATION IS ESTABLISHED PRIOR TO INITIATING FLARE OPERATION.

1. On initial startup, it is highly recommended to startup the Automatic/Manual HEI System in Manual mode in order to adjust pressure regulators and/or globe valves before starting in Automatic mode.
2. Ensure that the entire Flare System has been properly purged as instructed in Section 5.1 and that continuous purge gas is flowing.
3. If provided, open and close any manual drain valves in the Separator/Knockout Drum on the fuel gas inlet line in order to drain collected liquids.
4. The Pilot Failure Alarms (if included) will activate, lighting the corresponding “PILOT FAILURE” lamps on the front of the control panel. The pilot status lamps being lit in this start position verifies the operation of

the flame detection system in the cold, or flame out, condition.

5. To start the System in Automatic Mode:

    a. Open the hand valves in the fuel line to the pilots. Begin with the block valve(s) closest to the pilot (if included), opening the main pilot fuel gas block valve last. Adjust the pilot fuel gas regulator or globe valve to give 15 psig (1.05 kg/cm2g, 1.03 barg, 103 kPag) pressure at the fuel gas inlets for the pilots.
    b. Place all HEI MAN/OFF/AUTO switches in the AUTO position. This action provides power to the HEI Modules. These modules will provide a spark to the flare tip at a rate of one (1) spark per second. This sparking will continue until the sensing thermocouple or other flame monitoring equipment senses a flame.
    c. When a flame is detected, the power to the respective HEI module is turned off. The “PILOT FAILURE” lamp for that pilot is extinguished.
    d. Some systems may be provided with a timer that turns off the appropriate HEI module and issues an alarm in the event a flame is not sensed within a set period of time of spark initiation (typically ten minutes); more basic systems will continue to spark indefinitely until a flame is sensed or until operator intervention. Refer to the job specific control drawings and instrumentation drawings for additional information about what is included in this system.

6. To start the System in Manual Mode:

    a. Open the hand valves in the fuel line to the pilots. Begin with the block valve(s) closest to the pilot (if included), opening the main pilot fuel gas block valve last. Adjust the pilot fuel gas regulator or globe valve to give 15 psig (1.05 kg/cm2g, 1.03 barg, 103 kPag) pressure at the fuel gas inlets for the pilots.
    b. Turn the HEI MAN/OFF/AUTO selector switch for the pilot to be ignited to the MAN position, and hold. This action provides power to the HEI Modules. These modules will provide a spark to the pilot tip at a rate of one (1) spark per second. Some systems may have only one such switch which will attempt to ignite all pilots included as part of the system simultaneously.
    c. When the “PILOT FAILURE” lamp for the corresponding pilot is no longer lit, release the selector switch and it will spring return to the OFF position. If a pilot flame detection system is inoperable, continue holding the switch in the MAN position until a pilot flame is visually verified.
    d. To proceed with Automatic operation, turn the HEI MAN/OFF/AUTO selector switch to the AUTO position. Otherwise, return the HEI MAN/OFF/AUTO selector switch to the OFF position. Leave the pilot fuel gas line(s) open.

e. Repeat this procedure if applicable for subsequent pilots to be ignited.

7. After ignition of all pilots has been verified (“PILOT FAILURE” lights extinguished), flare gas can be safely admitted to the system.

5.4.3 Normal Operation

1. The “Power” switch should be left in the “On” position during normal operation. System power is required for automatic re-light, issuance of alarms (if included) and activation of pilot flame failure lamps.
2. If a pilot should fail during normal operation and the operating switch is in the “Auto” position, the “PILOT FAILURE” lamp will illuminate, and a relight will be attempted automatically. If the relight is successful, the “PILOT FAILURE” lamp will extinguish.
3. If a pilot should fail during normal operation and the operating switch is in the “Off” position, the “PILOT FAILURE” lamp will illuminate. No automatic relight will be attempted. Operator interface at the local control panel will be required to initiate a manual relight.

5.5 Series LMM Flare Front Generator

5.5.1 Pre-Commissioning

1. Please refer to the Recommended Purging Procedures in Section 5.1 for additional information.
2. Confirm that all equipment is installed and assembled in accordance with all applicable drawings and with applicable industry and site specific safety specifications.
3. Confirm that all mechanical and electrical connections are properly made.
4. Confirm that all gas and instrument air connections are airtight and all bolts are properly torqued.
5. Check that all electrical wiring is free from breaks as verified by continuity testing.
6. Ensure that electrical power, instrument air, and fuel are properly supplied to the LMM rack.
7. Open and close any drain valves in the FFG lines to ensure that there is no water accumulation in these lines. If moisture is found to be present in these lines, flow compressed air through the lines until thoroughly dried.

5.5.2 Startup

WARNING!

VERIFY THAT THE FLARE SYSTEM HAS BEEN PROPERLY PURGED PRIOR TO INITIATING PILOT OPERATION. FAILURE TO PROPERLY PURGE THE SYSTEM MAY RESULT IN EXPLOSION. VERIFY THAT ALL FLARE PILOTS ARE IGNITED AND THAT STABLE PILOT OPERATION IS ESTABLISHED PRIOR TO INITIATING FLARE OPERATION.

1. Initial startup of the Series LMM Flame Front Generator may require two operators in order to simultaneously operate the control panel and verify ignition at the ignition chamber sight glass.
2. Start up of the Flare System will begin with the purging of the Flare System for ten (10) volume changes. This will help ensure a safe start up. Purge the Flare System with an inert gas that will not reach its dew point at any time during the purging process. Since this Flare Tip is in close proximity to other Flare Systems, this Flare System must be purged with an inert gas on initial startup whenever other nearby Flare Systems may be in operation. Refer to the Recommended Purge Rates in the Utility Requirements Appendix in Section 10 of this manual and on the Zeeco Flare Tip Assembly drawing and to the Recommended Purge Procedures in Section 5.1. Purge until ten times the volume of the system has been replaced, then continue purge throughout the light-off period.
3. Start with all valves associated with the LMM system closed and all switches in the off position.
4. Energize System with the “Power” switch located on the control panel enclosure. The Pilot Failure Alarms (if included) will activate, lighting the corresponding “PILOT FAILURE” or “LOW TEMPERATURE” lamps on the front of the control panel.
5. Open and close any drain valves in the FFG lines to ensure that there is no water accumulation in these lines. If the FFG lines slope towards the ignition rack, it may be necessary to open the pilot select valve for each pilot to allow any water to reach the drain valve located on the FFG rack. If moisture is found to be present in these lines, flow compressed air through the lines until thoroughly dried. When complete, close all drain lines. Close all pilot select valves before proceeding with startup.
6. Open the pilot fuel gas block valve(s). Begin with the block valve(s) closest to the pilot (if included), opening the main pilot fuel gas block valve last. The pilot gas regulator(s) or globe valve(s) should be set to give 15 psig (1.05 Kg/cm2g, 1.03 barg) pressure at the fuel gas inlets for the pilots.
7. Adjust ignition valves so that the FFG output will go to the pilot that is to be lit. Only one ignition valve, for selection of a single pilot, should be

open at a time. **The ignition system is capable of lighting only one pilot at a time.**

8. Open the ignition fuel gas block valves (if provided). Set regulator or adjust globe valve to give 15 psig (1.05 Kg/cm2g, 1.03 barg) at the ignition chamber.
9. Open the ignition air block valves (if provided). Set regulator or adjust globe valve to give 15 psig (1.05 Kg/cm2g, 1.03 barg) at the ignition chamber. Gas flow should be audible to an operator at the LMM rack.
10. Allow time for the mixture of gas and air to fill the 1” line to the flare pilot. This is normally about one second per 70 feet (21 meters) of length between the FFG and the flare tip.
11. Push and release the ignition button on the FFG panel. Do not hold the button in the down position; a single spark is the most effective. This action ignites the fuel/air mixture in the 1” ignition tube to the pilot. When the flame front reaches the end of the ignition tube at the pilot tip, the pilot will ignite.
12. After the pilot is properly lit, the corresponding “PILOT FAILURE” or “LOW TEMPERATURE” lamp should go out, verifying the flame detection system in the “flame on” condition. If a pilot flame detection system is not included or inoperable, pilot flame must be visually verified.
13. Repeat the above steps 7 through 12 for each pilot to be lit.
14. Close the block valves supplying fuel and air to the FFG Ignition chamber. Leave the pilot fuel gas line(s) open.
15. The “Power” switch should be left in the “On” position during normal operation. System power is required for issuance of alarms (if included) and activation of pilot flame failure lamps.
16. After ignition of all pilots has been verified (“PILOT FAILURE” or “LOW TEMPERATURE” lights extinguished) flare gas can be safely admitted to the system.

6 SPARE PARTS

A recommended spare parts list for your Zeeco Flare System is included in the Spare Parts Lists for Start-Up and Normal Operation Appendix in Section 10. Zeeco part numbers for all components are included on the job specific drawings. In order for any applicable guarantees to remain in effect and to ensure proper system operation, use only Zeeco spare parts for the maintenance of your Zeeco Flare System. For spare parts information and pricing, please contact:

Zeeco, Inc.
22151 East 91st Street
Broken Arrow, OK 74014 USA

Phone: 918-258-8551
Fax: 918-251-5519

World Wide Web: www.zeeco.com
E-Mail: sales@zeeco.com

7 SHUTDOWN

7.1 Normal Shutdown

WARNING!

THIS PROCEDURE IS PRESENTED AS A GUIDE ONLY. THE EXACT PROCEDURE FOR YOUR JOBSITE IS A FUNCTION OF THE EQUIPMENT AVAILABLE, AND THE TRAINING AND ABILITIES OF THE PERSONNEL PERFORMING THE PROCEDURE. THIS PROCEDURE IS ONLY A GENERAL GUIDE.

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE SHUT-DOWN OF THE SERIES UF FLARE TIP. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY SHUT-DOWN OF OR REPAIR TO THE FLARE TIP.

Use the following procedure as a guide for shut-down of the Flare Tip:

1. Shut off the flare gas flow to the Flare stack using any block valves in Flare line.
2. Isolate the Flare stack by following the proper procedures outlined by plant operations.
3. Completely purge the Flare System from the isolation point to the Flare Tip with an inert, non-flammable gas.
4. Extinguish the pilot flames by shutting off gas flow to the pilots on the Flare tip.
5. Disable the pilot and direct spark ignition systems.

8 MAINTENANCE

8.1 Purge Gas System

Safe operation of the Flare System requires that there be no air, and thus no oxygen, present in the flared gases as they reach the pilots. The quantity of purge gas is set to avoid entry of air into the Flare System while the Flare is in operation and the pilots are burning. If it is required that the Flare System be opened for maintenance, extinguish the pilots before work begins and do not re-ignite them until after the system has been thoroughly purged. The Flare System must be absolutely gas tight before re-ignition.

8.2 Flare Stack

Normal Maintenance of the Flare Stack including structural, mechanical, and electrical should be made periodically to ensure that all systems are in safe operating order and properly functioning. Any items resulting from these checks should be promptly corrected.

Other items to check for during maintenance inspections are:

Junction Box(es) – Junction boxes should be inspected at every shutdown or at least once a year for integrity. Ensure that any included breather drains are operational.

8.3 Series MJ Flare Tip

WARNING!

THIS PROCEDURE IS PRESENTED AS A GUIDE ONLY. THE EXACT PROCEDURE FOR YOUR JOBSITE IS A FUNCTION OF THE EQUIPMENT AVAILABLE, AND THE TRAINING AND ABILITIES OF THE PERSONNEL PERFORMING THE PROCEDURE. ZEECO RECOMMENDS THAT TRAINED AND EXPERIENCED RIGGING PERSONNEL BE USED. PRIOR TO ANY LIFT, A THOROUGH PLAN SHOULD BE DRAWN UP AND APPROVED BY THE APPROPRIATE SITE SAFETY PERSONNEL. THIS PROCEDURE IS ONLY A GENERAL GUIDE.

Series MJ Flare Tip lifting lugs are only intended to be used during the FIRST LIFT of the Series MJ Flare Tip. It is recommended they be removed or disabled after installation. After a Series MJ Flare has been placed into service the lugs are in a heat-affected zone, and thus subject to thermal damage. Using the lugs for subsequent lifts is purely at the liability of others and not Zeeco. If the lugs are to be used for subsequent lifts, they should be thoroughly inspected by a qualified inspector and have had a dye penetrant test conducted on 100% of the welds of the lugs to the Series MJ Flare Tip shell. Series MJ Flare Tip lifting lugs may have been designed for vertical lifting only. Do not lift from horizontal without ensuring that lifting lugs are suitable for horizontal lifts.

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE MAINTENANCE OF THE SERIES MJ FLARE TIP. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY MAINTENANCE OF OR REPAIR TO THE SERIES MJ FLARE TIP.

The Series MJ Flare Tip requires little or no maintenance. There are no moving parts to replace or lubricate. The Flare Tip should be inspected at every shutdown or a minimum of once every 3–5 years.

Flare Tip Spider(s) – The ”spider” tip is in the heat affected zone and as a result is subject to deterioration during operation. A visual inspection should be performed. The visual inspection should ensure that it is securely mounted and that no cracks or corrosion are visible either on the inside or outside surfaces of the tip. If cracks or corrosion are present, replace tip. The condition of the gas ports should be assessed to ensure that there is no blockage in these ports. The ports may be cleaned using compressed air. Drilling of these ports is not recommended as it could enlarge the gas opening and compromise the proper operation of the ”spider” tip.

NOTE: Any damage to the Series MJ Flare Tip may warrant Flare Tip replacement. Contact Zeeco if damage to the Series MJ Flare Tip is found.

If repair or replacement of the Flare Tip is necessary, use the following procedure as a guide for removal of the Series MJ Flare Tip:

1. Shut-Down the Flare Tip. Refer to the Shut-Down procedures in Section 7.1.

2. Disconnect all attachment piping to the Flare Tip as follows: pilot gas supply lines, pilot thermocouple connections and pilot FFG ignition lines.
3. The crew demounting the Flare Tip should check any lifting lugs present by dye penetrant test to ensure structural integrity of the lifting lugs. The Flare Tip should be structurally checked for any damage or stress. Utilize visual inspection as well as NDE procedures to verify structural integrity of the Flare Tip.
4. Use spreader bars when possible for all Flare Tip lifts.
5. Tension the straps to hold the Flare Tip during removal of the flange bolting hard- ware.
6. Lift the Flare Tip to grade to complete the removal process.

8.4 Series HSLF Flare Pilot

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE MAINTENANCE OF THE HSLF PILOT. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY MAINTENANCE OF OR REPAIR TO THE HSLF PILOT.

To ensure proper pilot operation and longevity, the following system components should be inspected at each shutdown and replaced if defective:

Tip – The pilot tip is in the heat affected zone and as a result is subject to deterioration during operation. This deterioration is dependent on the type of pilot gas used. A visual inspection should be performed. The visual inspection should ensure that it is securely mounted and that no cracks or corrosion are visible either on the inside or outside surfaces of the tip. If cracks or corrosion are present, replace tip. The condition of the gas ports in- side the pilot tip should be assessed to ensure that there is no blockage in these ports. The ports may be cleaned using compressed air. Drilling of these ports is not recommended as it may enlarge the gas opening and compromise the proper operation of the pilot.

Mixer assembly – The mixer should be visually inspected to determine that it is securely mounted and that no cracks or corrosion are visible. If cracks or corrosion are present, replace mixer. The mixer should also be clean and free of debris. The mixer may be cleaned with compressed air or wiped with a cloth. The gas spud mounted in the base of the mixer assembly should be inspected to ensure that its gas port or ports are not blocked. If blockage is discovered, attempt to remove the blockage using compressed air. Drilling of these ports is not recommended as it may enlarge the gas opening and compromise the proper operation of the pilot.

Strainer(s) – Assure that the strainer is securely mounted and that no cracks or corrosion are visible. If cracks or corrosion are present, replace strainer. If strainer is intact, clean debris from strainer mesh and reinstall.

Mounting brackets – Assure that the brackets are securely mounted and that no cracks or corrosion are visible. If cracks or corrosion are present, replace bracket(s).

Weather-head(s) – Assure that all weather-heads are securely mounted and that no cracks or corrosion are visible. If cracks or corrosion are present, replace weather-head.

Thermocouples – Perform continuity check from grade. Damaged or malfunctioning thermocouples should be replaced at the next shutdown or immediately replaced from grade if retractable thermocouples or pilots are installed. **NOTE: It is good practice to replace all thermocouples used for pilot flame monitoring at EVERY shutdown.** Each thermocouple has been provided with an installed spare. Installed spares may be utilized by switching the thermocouples at the thermocouple transmitter. Refer to the job specific wiring diagrams for details.

Temperature Transmitters – Damaged or malfunctioning thermocouple temperature transmitters should be replaced as soon as convenient.

8.5 Series HEIC Ignition/LMM FFG System

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE MAINTENANCE OF THE HEI SYSTEM. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY MAINTENANCE OF OR REPAIR TO THE HEIC/LMM SYSTEM.

WARNING!

NEVER ATTEMPT TO SERVICE A ZEECO HIGH ENERGY IGNITION SYSTEM WITHOUT FIRST DISCONNECTING POWER TO THE UNIT.

To ensure proper system operation and longevity, the following system components should be inspected annually and replaced if defective:

Panel lights and pushbuttons — Test lights and pushbuttons. Replace as required. Safely disconnect system power in order to prevent sparking prior to replacing any electronic components located in a Hazardous Area.

Valves (if provided) — Assure that valves are operational. Check filters on any included automatic solenoid valves for plugging. Replace or repair as required, following the manufacturer's instructions included in the Vendor Information Appendix in Section 11.

Strainers — Assure that each strainer is securely mounted and that no cracks or corrosion are visible. If cracks or corrosion are present, replace strainer. If strainer is intact, clean debris from strainer mesh and reinstall.

Regulators — Assure that all regulators are properly calibrated and operating properly. Replace as required.

Pressure Indicators —Assure that all pressure indicators are calibrated and reading correctly. Replace as required.

Thermocouples —Perform continuity check from grade. Damaged or malfunctioning thermocouples should be replaced at the next shutdown or immediately replaced from grade if retractable thermocouples or pilots are installed. **NOTE: It is good practice to replace all thermocouples used for pilot flame monitoring at EVERY shutdown. Ignition Probe(s) —** If a pilot fails to ignite, test pilot Ignition Probe for spark. **DISCONNECT POWER TO THE HEI IGNITION SYSTEM.** Remove the Ignition Probe from the pilot. Connect the Ignition Probe directly to the HEI Ignition Module. Lay the Ignition Probe on the ground. **ENSURE THE IGNITION PROBE IS NOT IN CONTACT WITH ANY METALLIC OBJECTS OR STRUCTURES.** Re-connect power to the HEI Ignition System. While watching the tip of the Ignition Probe for verification, spark the Ignition Probe manually. If a vigorous spark is generated, the Ignition Probe and Ignition Module are operating normally. If no spark is generated, disconnect power to the HEI Ignition System and re-test the Ignition Probe by attaching it to a different Ignition Module. Replace any malfunctioning Ignition Probes and/or Ignition Modules as necessary.

Ignition Module(s) —No adjustment or cleaning of the Ignition Module is required, other than periodic inspection of the electrical connections. Replace with spare ignition module if it becomes defective.

9 TROUBLESHOOTING

WARNING!

ALL PLANT SAFETY PROCEDURES AND GUIDELINES MUST BE FOLLOWED DURING THE TROUBLESHOOTING OF THE ZEECO FLARE SYSTEM. CHECK WITH SITE SAFETY PERSONNEL TO DETERMINE WHAT PRECAUTIONS MUST BE TAKEN BEFORE BEGINNING ANY TROUBLESHOOTING OF OR REPAIR TO THE ZEECO FLARE SYSTEM.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
A red glow of the pilot shield is visible at night.	Pilot is operating properly	No action Required
Selected pilot will not light	Pilot is improperly installed	Refer to the pilot installation instructions and drawings in order to verify that the pilot is properly installed and wiring terminations are correctly made.
	Pilot mixer orifice is plugged	Refer to the maintenance section of this manual for instructions on cleaning the mixer orifice.
	Pilot fuel gas is incorrect or compromised	Verify that the pilots are receiving a fuel gas supply that is regulated to the proper pressure as shown on the flare tip assembly drawings and that the LHV of the fuel gas is greater than 300 Btu/scf (11,200 KJ/Nm3).
	Cannot establish flame front from FFG ignition chamber assembly	Review operating instructions and ensure that correct procedures are being followed.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
		Make sure the fuel gas and air are flowing to the ignition chamber assembly and that both are set at the proper pressure as indicated in Section 5.4.6. Also, check to make sure air…
		… supplied to the FFG is dry and free of moisture. If problem still exists, vary the fuel and air pressure settings slightly.
		Ensure that all valves are open on the fuel and air lines upstream of the ignition chamber assembly. Also, check for moisture in ignition lines and that all drain valves are closed.
		Determine if spark is being generated by spark plug. A viewing window is included on the ignition chamber assembly for this purpose. If not, replace the spark plug. If spark cannot be generated from the control panel after spark plug replacement, replace the ignition module inside the control panel.
	Flame front from FFG not reaching Pilots	Confirm that the ignition piping between the ignition chamber assembly and the pilot to be ignited are clear and that the valves in this line are in the open position. Valves in ignition lines to other pilots served by the same FFG should be in the closed position.
		If problem still exists, increase the time allowed for the fuel/air mixture to fill the ignition line.
	Flame front established, but pilot will not light	Confirm pilot fuel gas composition and pressure are per job specifications as indicated on flare tip assembly drawing.
		Confirm that all valves in the pilot gas line are open.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
Control system indicates that pilots are not burning	Pilot fuel gas supply does not meet operational requirements	Confirm pilot fuel gas composition and pressure are per job specific requirements as indicated on flare tip assembly drawing.
	Pilots are damaged or pilot mixers are plugged	Inspect pilots for tip or pilot mixer damage or plugging of the mixer orifice. Refer to the Maintenance section of this manual for Instructions on cleaning the mixer orifice. Replace tip and/or mixer if damaged.
	Pilot fuel lines are plugged	Inspect pilot fuel gas lines, clean per site specific recommendations if required.
	Pilot ignition lines are plugged	Inspect ignition lines, clean per site specific recommendations if required.
	Pilot thermocouple has failed	Perform continuity check for open circuit on thermocouple from grade. If no open circuit condition is found, verify thermocouple output is near specified value at ambient temperature with no flame present. Output values range from 0.397mV at 100° Fahrenheit (37.8° Celsius) for a Type K thermocouple. See job specific drawings for thermocouple type. Replace thermocouple if defective.
	Pilot thermocouple wiring has failed	Inspect thermocouple wiring and perform wiring continuity check for open circuit from grade.
	Pilot temperature switch (if provided) has failed	Test pilot temperature switch, replace if defective.
	Flame verification temperature settings are incorrect.	Contact Zeeco for proper temperature set points and instructions for adjusting these set points.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
Ignition lines on FFG are very hot	Manual ignition button is depressed	Release manual ignition button. The ignition button should be depressed and released quickly, as a single spark is most effective in establishing a flame front inside the ignition chamber.
	Automatic ignition sequence is not correct	Review regulator settings and ignition sequencing against the job specific drawings and documentation.
	Fuel gas composition to FFG is not per the design specifications	The FFG is customized for the fuel composition as specified to Zeeco during the design phase. If fuel gas is different from that provided by the customer design requirements, which may be indicated in the Customer Process Data Sheets Appendix in Section 10 , contact a Zeeco engineer to determine what adjustments may be required to the FFG system for operation with the revised fuel gas composition.
	Improper fuel/air ratio in the ignition chamber assembly	See the Section 5.4.6 above for instructions for setting air and ignition gas regulators. Please note that some adjustment to the regulators may be…
		…required due to varying fuel gas and environmental conditions. Some trial and error to find the optimum fuel and air regulator settings is expected.
Cannot Regulate air or gas to FFG	Pressure regulators or globe valves are not installed	Install pressure regulators or globe valves in gas and/or air supply lines. Refer to job specific drawings.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
	Pressure regulators are improperly installed	Refer to pressure regulator manual and verify that it has been installed per manufacturer's recommendations and per job specific requirements as indicated on the FFG Assembly Drawing.
	Air, gas and/or ignition lines are plugged	Inspect air, gas and ignition lines, clean per site specific recommendations if required
	Air or gas supply pressure is too low	Confirm supply pressures are per job specific requirements as indicated on the FFG Assembly drawing.
Explosions heard inside flare stack	Purge gas is not flowing or flow is too low	Confirm that the purge gas flow to the flare is at the rate as given in the Utility Requirements Appendix in Section 11 or Zeeco Flare Tip Assembly drawing.
	Air is leaking in the flare header or stack	Inspect the flare gas header and flare stack for sources of air leakage. Seal any air leaks that are discovered.
	Flare gas contains oxygen	Check the flare gas composition to determine if oxygen is present. If it is present, adjust process conditions to eliminate oxygen from the flare gas.
	Gas Seal drain is allowing air ingress	Check for leaks in drain line.
Excessive corrosion at the flare stack base	Oxygen is entering the flare stack	Check for air leakage in the flare header and for oxygen in the flared gasses. Seal air leaks and adjust process conditions to eliminate oxygen from the flare gas.
	Continuous water flow on Liquid Seal has failed	Confirm continuous water flow system is functioning properly.
	Liquid Seal make-up water is causing corrosion	Check PH level for Liquid Seal make-up water.
Utility piping is distorted at grade	Utility piping brackets are anchored in place.	Ensure that utility piping guide brackets are NOT anchored to the flare stack.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
Flare gas exiting the tip will not light	Pilots are not burning	Light the pilots per the pilot and ignition system operating instructions. If pilots will not light per operating instructions refer to the troubleshooting section titled “Pilot will not light”
	Flare gas heating value is too low	For stable combustion to take place at the flare tip, the flare gas must be above 300 Btu/scf (1,200 KJ/Nm3) in heating value. Verify the flare gas heating value and if it is found to be below 300 Btu/scf (11,200 KJ/Nm3) add assist gas until 300 Btu/scf (11,200 KJ/Nm3) heating value is reached. **WARNING: Before adding assist gas, it is important to confirm that the flare capacity will not be exceeded by the additional volume of assist gas.**
	Flare gas flow is too low	Increase the flare gas flow rate to the minimum purge rate. This flow rate should be given in the Utility Requirements Appendix in Section 11 and on the Flare Tip and Gas Seal Assembly Drawings.
Flare is smoking	Flare gas flow rate exceeds smokeless capacity of the flare tip	Reduce flare gas flow rate if possible. Design smokeless flow rate is as given in the Customer Process Data Sheets Appendix in Section 11. Consult Zeeco for information on modifying or replacing the tip to accommodate larger flows.
	Flare gas composition has changed	Confirm that the flare gas is per the design composition. Design flare gas compositions are as given in the Customer Process Data Sheets Appendix in Section 11. If the flare gas composition cannot be restored to the design conditions, consult Zeeco for information on modifying or replacing the tip to provide smokeless operation for the new gas composition.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
	Air assist blower is off or on low speed	Verify that the air assist blower is operating properly and is running at the recommended speed. Consult the Blower Operation Manual in the Blower Information Appendix in Section 11 for information on troubleshooting the blower.
	Flare gas flow rate exceeds smokeless capacity of the Air-Assist Blower	Reduce flare gas flow rate if possible. Design smokeless flow rate is as given in the Customer Process Data Sheets Appendix in Section 11. Consult Zeeco for information on replacing the Air-Assist Blower to provide greater capacity.
A red glow of the flare tip body is visible at night	Air is leaking into the flare tip body	Inspect the flare tip and flare gas header for sources of air leakage. Seal any air leaks that are discovered.
	Purge gas is not flowing or purge gas flow is too low	Confirm that the purge gas flow to the flare is at the rate as given in the Utility Requirements Appendix in Section 11 and on the Flare Tip and Gas Seal assembly drawing(s).
	Gas Seal drain is allowing air ingress	Check for leaks in drain line.
Flare is producing excessive noise	Pulsating flame	If a Gas Seal purge reduction device is installed as part of the Flare System, the seal may have liquid accumulation. Check the seal drain lines for any obstructions and clear as required to allow water to drain from the seal.
	Pilot gas composition has changed	Confirm that the pilot gas composition is per the design pilot gas composition. If design pilot gas composition cannot be restored, consult Zeeco for information about adjustments that may be required to the pilot design.
Pulsating flame	Gas seal is filled with liquid	Check the gas seal drain lines for any obstructions and clear as required to allow water to drain from the seal.

PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
Radiation readings are too high	Flare gas flow rate exceeds design capacity of the flare tip	Reduce flare gas flow rate if possible. Design flow rate is as given in the Customer Process Data Sheets Appendix in Section 10. Consult Zeeco for information on modifying or replacing the tip to accommodate larger flows.

10 APPENDIX

A Customer Process Data Sheets

B Utility Requirements

C Spare Parts Lists

D Zeeco Project Drawings

E Instrument Data Sheets and Piping Equipment Data Sheets

F Erection Procedure

G Vendor Information

APPENDIX A

Customer Process Data Sheets

Process Conditions -- English Units

Client:	CNX Gas	Zeeco Ref.:	T12554F	Date:	20-Oct-11
Location:	Majorsville, W.V.	Client Ref.:	100MMSCFD Flare	Rev.	1

	Mol %					
	Case A	Case B	Case C	Case D	Case E	Case F
METHANE	72.850					
ETHANE	16.388					
PROPANE	6.463					
BUTANE	2.532					
PENTANE	0.799					
HEXANE	0.486					
HEPTANE						
OCTANE						
NONANE						
DECANE						
DODECANE						
TRIDECANE						
CYCLOPENTANE						
ETHYLENE						
PROPYLENE						
BUTYLENE						
ACETYLENE						
BENZENE						
TOLUENE						
XYLENE						
CARBON MONOXIDE						
CARBON DIOXIDE	0.075					
HYDROGEN SULFIDE	0.000					
SULFUR DIOXIDE						
AMMONIA						
AIR						
HYDROGEN						
OXYGEN						
NITROGEN	0.403					
WATER						
BUTADIENE						
METHANOL	0.000					
Total	**100**					
Mol. Wt.	22.08					
L. H. V. (BTU/SCF):	1,204					
Temperature (Deg. F):	120.0					
Avail. Static Pressure (psig):	160.00					
Flow Rate (lbs/hr):	242,467					
Smokeless Rate (lbs/hr):	242,467					

ATTACHMENT N

Supporting Emission Calculations

Cone Midstream Partners LP - Oxford Station
Facility-Wide Emissions Summary

	Oxford Station Existing Facility Wide	Dehydration Unit with Combustor	Microturbines	Blowdown Flare	Reboiler	Condensate + Produced Water Storage Tanks	Gun Barrel Storage Tank	Tank Liquid Loading Operations	Oxford Station TOTAL	
Emissions Unit ID	**ALL**	**SV-2 & CMB-2**	**TRB-1 & TRB-2**	**BDF-1**	**BLR-2**	**Tank 2 & 3 & VDU1**	**Tank-1a**	**BL-1**		
Equipment Status	**Existing**	**New**	**New**	**New**	**New**	**New**	**New**	**New**		
Fuel Type	**----**	**---**	**Natural Gas**	**Natural Gas**	**Natural Gas**	**NA**	**NA**			
Capacity	**NA**	**67**	**200**	**100**	**1.00**	**16,800**	**18,900**	**NA**		
Unit	**NA**	**MMSCFD**	**KW**	**MMBtu/hr**	**MMBtu/hr**	**gallons**	**gallons**			
# of Emission Units	**ALL**	**1**	**2**	**1**	**1**	**2**	**1**	**ALL**		
Hours per Year	**8760**	**8,760**	**8,760**	**8,760**	**8,760**	**8,760**	**8,760**	**8,760**		
Pollutant	**tpy**	**tpy**	**tpy**	**tpy**	**tpy**		**tpy**	**tpy**	**lb/hr**	**tpy**
PM_{10}	0.68	0.16	0.13	0.00	0.03	0.25	---	---	**0.29**	**1.2**
$PM_{2.5}$	0.68	0.16	0.13	0.00	0.03	0.25	---	---	**0.29**	**1.2**
SO_X	0.04	0.01	0.07	0.00	0.00	0.02	---	---	**0.03**	**0.1**
CO	7.43	1.78	1.93	0.05	0.29	2.72	---	---	**3.24**	**14.2**
NO_X	9.16	2.12	0.70	0.06	0.35	3.24	---	---	**3.57**	**15.6**
VOC (incl. HCHO)	6.41	5.49	0.18	---	0.02	2.56	76.55	0.27	**20.88**	**91.5**
CO_2	---	3,143	2,330	84	512	---	---	---	**1,386**	**6,069**
CH_4	---	4.42	0.04	0.00	0.01	---	---	---	**1.02**	**4**
N_2O	---	0.01	0.00	0.00	0.00	---	---	---	**0.00**	**0.0**
CO_2e	8,923	3,255	2,333	84	513	---	---	---	**3,449**	**15,108**
Formaldehyde	0.04	---	0.01	---	0.000	---	---	---	**0.01**	**0.1**
Total HAPs (including HCHO)	0.22	1.30	0.02	---	0.01	0.16	7.23	0.01	**2.04**	**8.9**

1. VOC and HAP emissions are included in the storage tank emissions.
2. NOx, PM_{10}, $PM_{2.5}$, SO_x, and CO emissions from the Ground Combustor and have been included in the dehydrator emissions
2. NOx, PM_{10}, $PM_{2.5}$, SO_x, and CO emissions from the Vapor Destruction Unit have been included in the storage tank emissions

Dehydration Unit & Combustor Emissions

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY
Controlled Regenerator Emissions

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	0.0754	1.81	0.330
Methane	0.0099	0.24	0.043
Ethane	0.0127	0.30	0.056
Propane	0.0187	0.45	0.082
Isobutane	0.0063	0.15	0.028
n-Butane	0.0182	0.44	0.080
Isopentane	0.0085	0.21	0.037
n-Pentane	0.0117	0.28	0.051
n-Hexane*	0.0138	0.33	0.061
Cyclohexane	0.0129	0.31	0.057
Other Hexanes	0.0150	0.36	0.066
Heptanes	0.0314	0.75	0.138
2,2,4 Trimethylpentane*	0.0001	0.00	0.000
Benzene*	0.0489	1.17	0.214
Toluene*	0.1117	2.68	0.489
Ethylbenzene*	0.0000	0.00	0.000
Xylenes*	0.0488	1.17	0.214
C8+ Heavier Hydrocarbons	0.1173	2.82	0.514
Total Emissions	0.5177	12.43	2.268
Total Hydrocarbon Emissions	0.5177	12.43	2.268
Total VOC Emissions	0.4952	11.89	2.169
Total HAP Emissions	0.2234	5.36	0.978

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY
Flash Gas Emissions

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	0.5620	13.49	2.462
Methane	0.8954	21.49	3.922
Ethane	0.3622	8.69	1.586
Propane	0.2113	5.07	0.925
Isobutane	0.0490	1.18	0.215
n-Butane	0.1082	2.60	0.474
Isopentane	0.0457	1.10	0.200
n-Pentane	0.0506	1.22	0.222
n-Hexane*	0.0343	0.82	0.150
Cyclohexane	0.0091	0.22	0.040
Other Hexanes	0.0495	1.19	0.217
Heptanes	0.0403	0.97	0.176
2,2,4 Trimethylpentane*	0.0002	0.00	0.001
Benzene*	0.0041	0.10	0.018
Toluene*	0.0063	0.15	0.028
Ethylbenzene*	0.0000	0.00	0.000
Xylenes*	0.0011	0.03	0.005
C8+ Heavier Hydrocarbons	0.0161	0.39	0.070
Total Emissions	1.9011	45.627	8.33
Total Hydrocarbon Emissions	1.9011	45.627	8.33
Total VOC Emissions	0.6435	15.444	2.819
Total HAP Emissions	0.0460	1.10	0.201

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY [1]
Combined Regenerator and Flash Gas Emissions [1]

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	0.7011	16.8274	3.0710
Methane	0.9958	23.8997	4.3617
Ethane	0.4124	9.8967	1.8061
Propane	0.2530	6.0709	1.1078
Isobutane	0.0608	1.4608	0.2666
n-Butane	0.1390	3.3374	0.6091
Isopentane	0.0596	1.4322	0.2615
n-Pentane	0.0685	1.6467	0.3005
n-Hexane*	0.0529	1.2716	0.2320
Cyclohexane	0.0242	0.5819	0.1064
Other Hexanes	0.0710	1.7028	0.3108
Heptanes	0.0789	1.8920	0.3453
Methylcyclohexane*	0.0003	0.0046	0.0012
Benzene*	0.0583	1.4003	0.2555
Toluene*	0.1298	3.1152	0.5684
Ethylbenzene*	0.0000	0.0000	0.0000
Xylenes*	0.0549	1.3178	0.2405
C8+ Heavier Hydrocarbons	0.1467	3.5211	0.6425
Total Emissions	2.6607	63.8583	11.6541
Total Hydrocarbon Emissions	2.6607	63.8583	11.6541
Total VOC Emissions	1.2526	30.0619	5.4864
Total HAP Emissions	0.2963	7.1104	1.2978

*HAPs

Ground Combustor (CMB2) Emissions Calculations:

Combustor Rating	6.0	MMbtu/hr
Pilot Rating	0.13	MMbtu/hr
Higher Heating Value (HHV)	1,265	btu/scf

Pollutant	Emission Factors [2] (lb/MMBtu)	Combustor Potential Emissions (lb/hr)	Combustor Potential Emissions (tpy)	Pilot Potential Emissions (lb/hr)	Pilot Potential Emissions (tpy)
NO_x	0.079	0.47	2.08	0.01	0.04
CO	0.066	0.40	1.74	0.01	0.04
PM/PM_{10}	0.006	0.04	0.16	0.00	0.00
SO_2	0.000	0.00	0.01	6.00E-05	2.63E-04
CO_2 [3] (Natural Gas Firing)	116.997	701.98	3074.69	14.80	64.84
CH_4 [3] (Natural Gas Firing)	0.002	0.01	0.06	2.79E-04	1.22E-03
N_2O [3] (Natural Gas Firing)	0.000	0.001	0.006	2.79E-05	1.22E-04

1. Based on GRI GLYCalc 4.0 run at dry gas flowrate of 67 MMSCFD, and T and P of 100°F and 450 psig, respectively. Regenerator Still and Flash Tank emissions are controlled by the enclosed flare at a destruction efficiency of 98%. 10% compliance margin included in total dehy emissions.

2. Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3 & 1.4-4.

3. GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Reboiler

Source Designation:	
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,265
Heat Input (MMBtu/hr)	1.00
Fuel Consumption (MMscf/hr):	7.90E-04
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[b]	(tons/yr)[c]
NO_x	100	0.08	0.35
CO	84	0.07	0.29
SO_2	0.6	0.000	0.002
PM Total	7.6	0.01	0.03
PM Condensable	5.7	0.005	0.02
PM_{10} (Filterable)	1.9	0.002	0.01
$PM_{2.5}$ (Filterable)	1.9	0.00	0.01
VOC	5.5	0.004	0.02
CO_2 [d] (Natural Gas Firing)	148,034	117.00	512.45
CH_4 [d] (Natural Gas Firing)	2.8	0.00	0.01
N_2O [d] (Natural Gas Firing)	0.28	0.00	0.00

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[b]	(tons/yr)[c]
HAPs:			
3-Methylchloranthrene	1.8E-06	1.42E-09	6.23E-09
7,12-Dimethylbenz(a)anthracene	1.6E-05	1.26E-08	5.54E-08
Acenaphthene	1.8E-06	1.42E-09	6.23E-09
Acenaphthylene	1.8E-06	1.42E-09	6.23E-09
Anthracene	2.4E-06	1.90E-09	8.31E-09
Benz(a)anthracene	1.8E-06	1.42E-09	6.23E-09
Benzene	2.1E-03	1.66E-06	7.27E-06
Benzo(a)pyrene	1.2E-06	9.48E-10	4.15E-09
Benzo(b)fluoranthene	1.8E-06	1.42E-09	6.23E-09
Benzo(g,h,i)perylene	1.2E-06	9.48E-10	4.15E-09
Benzo(k)fluoranthene	1.8E-06	1.42E-09	6.23E-09
Chrysene	1.8E-06	1.42E-09	6.23E-09
Dibenzo(a,h) anthracene	1.2E-06	9.48E-10	4.15E-09
Dichlorobenzene	1.2E-03	9.48E-07	4.15E-06
Fluoranthene	3.0E-06	2.37E-09	1.04E-08
Fluorene	2.8E-06	2.21E-09	9.69E-09
Formaldehyde	7.5E-02	5.93E-05	2.60E-04
Hexane	1.8E+00	1.42E-03	6.23E-03
Indo(1,2,3-cd)pyrene	1.8E-06	1.42E-09	6.23E-09
Phenanthrene	1.7E-05	1.34E-08	5.88E-08
Pyrene	5.0E-06	3.95E-09	1.73E-08
Toluene	3.4E-03	2.69E-06	1.18E-05
Arsenic	2.0E-04	1.58E-07	6.92E-07
Beryllium	1.2E-05	9.48E-09	4.15E-08
Cadmium	1.1E-03	8.69E-07	3.81E-06
Chromium	1.4E-03	1.11E-06	4.85E-06
Cobalt	8.4E-05	6.64E-08	2.91E-07
Lead	5.0E-04	3.95E-07	1.73E-06
Manganese	3.8E-04	3.00E-07	1.32E-06
Mercury	2.6E-04	2.05E-07	9.00E-07
Nickel	2.1E-03	1.66E-06	7.27E-06
Selenium	2.4E-05	1.90E-08	8.31E-08
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.4E-05	1.90E-08	8.31E-08
Naphthalene	6.1E-04	4.82E-07	2.11E-06
Total HAP		**1.49E-03**	**6.54E-03**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3 & 1.4-4.
[b] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).
[c] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).
[d] GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Gun Barrel Storage Tank

Electric Vapor Recovery Unit:

Capture and Control efficiency of VRU	95%
Maximum Downtime of VRU	5%

Estimated Potential Throughput

Operational Hours	8,760 hrs/yr
Condensate Throughput	100 bbls/day
Produced Water throughput	50 bbls/day

Description	Maximum Throughput [1] (gal/yr)	Maximum Throughput (gal/hr)
Produced Fluids	2,300,000	262.56

[1] Throughput (gal/yr) = (condensate + produced water)bbl/day x 365 days/yr x 42 gal/bl

Storage Tanks (T001a) - Uncontrolled

Constituent	Working Emissions tpy	Breathing Emissions tpy	Flashing Emissions tpy	Total Emissions [1] lb/hr	Total Emissions [1] tpy
Propane	0.814	0.156	379.100	86.774	380.070
Isobutane	0.297	0.057	141.900	32.478	142.254
n-Butane	0.710	0.136	335.400	76.768	336.246
Isopentane	0.356	0.068	180.100	41.216	180.524
n-Pentane	0.350	0.067	178.800	40.917	179.217
n-Hexane	0.011	0.002	73.870	16.868	73.883
Methylcyclopentane	0.019	0.004	11.050	2.528	11.073
Benzene	0.000	0.000	2.709	0.619	2.709
Cyclohexane	0.001	0.000	7.733	1.766	7.734
n-Heptane	0.096	0.018	54.280	12.419	54.395
n-Octane	0.013	0.002	7.305	1.671	7.320
n-Nonane	0.002	0.000	1.084	0.248	1.086
n-Decane	0.000	0.000	0.106	0.024	0.106
n-Undecane	0.000	0.000	0.008	0.002	0.008
Dodecane	0.000	0.000	0.001	0.000	0.001
Triethylene Glycol	0.000	0.000	0.000	0.000	0.000
Cyclopentane	0.000	0.000	0.000	0.000	0.000
Isohexane	0.168	0.032	86.110	19.705	86.310
3-Methylpentane	0.067	0.013	34.200	7.826	34.279
Neohexane	0.014	0.003	7.046	1.612	7.062
2,3-Dimethylbutane	0.030	0.006	15.350	3.513	15.386
Methylcyclohexane	0.014	0.003	8.238	1.885	8.255
Isooctane	0.000	0.000	0.199	0.046	0.200
Decane, 2-Methyl-	0.000	0.000	0.053	0.012	0.053
Toluene	0.001	0.000	2.248	0.513	2.249
m-Xylene	0.000	0.000	0.249	0.057	0.249
Ethylbenzene	0.000	0.000	0.238	0.054	0.238
Total Emissions:	2.96	0.57	1527.38	349.52	1530.91
Total VOC Emissions:	2.96	0.57	1527.38	349.52	1530.91
Total HAP Emissions:	0.14	0.03	144.35	32.99	144.51

1. ProMax software provides estimates for working, breathing, and flashing losses associated with total throughput (i.e., emissions represent total from all tanks at the facility).The Gun barrel storage tank emissions will be controlled primarily by an electric vapor recovery unit with 95% destruction efficiency. The VDU will act as a backup control device should the VRU fail.

Storage Tanks (T001a) - Controlled

Constituent	Total Emissions [1] lb/hr	tpy
Propane	4.339	19.004
Isobutane	1.624	7.113
n-Butane	3.838	16.812
Isopentane	2.061	9.026
n-Pentane	2.046	8.961
n-Hexane	0.843	3.694
Methylcyclopentane	0.126	0.554
Benzene	0.031	0.135
Cyclohexane	0.088	0.387
n-Heptane	0.621	2.720
n-Octane	0.084	0.366
n-Nonane	0.012	0.054
n-Decane	0.001	0.005
n-Undecane	0.000	0.000
Dodecane	0.000	0.000
Triethylene Glycol	0.000	0.000
Cyclopentane	0.000	0.000
Isohexane	0.985	4.315
3-Methylpentane	0.391	1.714
Neohexane	0.081	0.353
2,3-Dimethylbutane	0.176	0.769
Methylcyclohexane	0.094	0.413
Isooctane	0.002	0.010
Decane, 2-Methyl-	0.001	0.003
Toluene	0.026	0.112
m-Xylene	0.003	0.012
Ethylbenzene	0.003	0.012
Total Emissions:	17.48	76.55
Total VOC Emissions:	17.48	76.55
Total HAP Emissions:	1.65	7.23

Storage Tanks

Vapor Destruction Unit (VDU-1) Emissions Calculations:

Enclosed Flare Rating	9.21	MMbtu/hr
Pilot Rating	0.15	MMbtu/hr
Higher Heating Value (HHV)	1,265	btu/scf
Control Efficiency	95%	

Pollutant	Emission Factors [1] (lb/MMBtu)	Combustor Potential Emissions (lb/hr)	Combustor Potential Emissions (tpy)	Pilot Potential Emissions (lb/hr)	Pilot Potential Emissions (tpy)
NO_x	0.079	0.73	3.19	0.01	0.05
CO	0.066	0.61	2.68	0.01	0.04
PM/PM_{10}	0.006	0.06	0.24	0.00	0.00
SO_2	0.000	0.00	0.02	0.00	3.12E-04
CO_2 [2] (Natural Gas Firing)	116.997	1077.55	4719.65	17.55	76.87
CH_4 [2] (Natural Gas Firing)	0.002	0.02	0.09	0.00	1.45E-03
N_2O [2] (Natural Gas Firing)	0.000	0.00	0.009	0.00	1.45E-04

1. Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3 & 1.4-4.
2. GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Estimated Potential Throughput

Operational Hours	8,760	hrs/yr
Condensate Throughput	100	bbls/day
Produced Water throughput	50	bbls/day

Description	Maximum Throughput [1] (gal/yr)	Maximum Throughput (gal/hr)
Condensate + Produced Water	2,300,000	262.56

[1] Throughput (gal/yr) = bbl/day x 365 days/yr x 42 gal/bb

Storage Tanks (T002 & T003) - Uncontrolled

Constituent	Working Emissions tpy	Breathing Emissions tpy	Flashing Emissions tpy	Total Emissions [1] lb/hr	Total Emissions [1] tpy
Propane	2.132	0.696	11.890	3.360	14.718
Isobutane	0.791	0.258	4.558	1.280	5.607
n-Butane	1.817	0.593	10.300	2.902	12.710
Isopentane	0.760	0.248	4.640	1.290	5.648
n-Pentane	0.704	0.230	4.346	1.205	5.279
n-Hexane	0.017	0.006	1.469	0.341	1.492
Methylcyclopentane	0.032	0.010	0.222	0.060	0.263
Benzene	0.000	0.000	0.055	0.013	0.055
Cyclohexane	0.002	0.001	0.152	0.035	0.154
n-Heptane	0.146	0.048	1.002	0.273	1.196
n-Octane	0.019	0.006	0.131	0.036	0.156
n-Nonane	0.003	0.001	0.019	0.005	0.023
n-Decane	0.000	0.000	0.002	0.001	0.002
n-Undecane	0.000	0.000	0.000	0.000	0.000
Dodecane	0.000	0.000	0.000	0.000	0.000
Triethylene Glycol	0.000	0.000	0.000	0.000	0.000
Cyclopentane	0.000	0.000	0.000	0.000	0.000
Isohexane	0.289	0.094	1.783	0.494	2.166
3-Methylpentane	0.113	0.037	0.698	0.194	0.848
Neohexane	0.025	0.008	0.155	0.043	0.189
2,3-Dimethylbutane	0.052	0.017	0.323	0.089	0.392
Methylcyclohexane	0.021	0.007	0.152	0.041	0.181
Isooctane	0.001	0.000	0.004	0.001	0.004
Decane, 2-Methyl-	0.000	0.000	0.001	0.000	0.001
Toluene	0.001	0.000	0.041	0.010	0.042
m-Xylene	0.000	0.000	0.004	0.001	0.005
Ethylbenzene	0.000	0.000	0.004	0.001	0.005
Total Emissions:	6.92	2.26	41.95	11.68	51.14
Total VOC Emissions:	6.92	2.26	41.95	11.68	51.14
Total HAP Emissions:	0.23	0.08	2.91	0.73	3.21

1. ProMax software provides estimates for working, breathing, and flashing losses associated with total throughput (i.e., emissions represent total from all tanks at the facility).Storage Tank emissions will be controlled by an enclosed tank battery flare with 95% destruction efficiency

Storage Tanks (T002 & T003) - Controlled

Constituent	Total Emissions [1] lb/hr	tpy
Propane	0.168	0.736
Isobutane	0.064	0.280
n-Butane	0.145	0.636
Isopentane	0.064	0.282
n-Pentane	0.060	0.264
n-Hexane	0.017	0.075
Methylcyclopentane	0.003	0.013
Benzene	0.001	0.003
Cyclohexane	0.002	0.008
n-Heptane	0.014	0.060
n-Octane	0.002	0.008
n-Nonane	0.000	0.001
n-Decane	0.000	0.000
n-Undecane	0.000	0.000
Dodecane	0.000	0.000
Triethylene Glycol	0.000	0.000
Cyclopentane	0.000	0.000
Isohexane	0.025	0.108
3-Methylpentane	0.010	0.042
Neohexane	0.002	0.009
2,3-Dimethylbutane	0.004	0.020
Methylcyclohexane	0.002	0.009
Isooctane	0.000	0.000
Decane, 2-Methyl-	0.000	0.000
Toluene	0.000	0.002
m-Xylene	0.000	0.000
Ethylbenzene	0.000	0.000
Total Emissions:	0.58	2.56
Total VOC Emissions:	0.58	2.56
Total HAP Emissions:	0.04	0.16

Liquid Loading

Liquid Loading Emissions - BL-1

Description	Maximum Throughput (gal/yr)	Controlled VOC Emissions (tpy)
Liquids Hauling	2,300,000	0.27

1. Based on total annual liquid throughput at the station. Emission calculations are based on Promax Run for submerged vapor balanced service and overall reduction efficiency of 96.73 percent

Constituent	Total Emissions [1] lb/hr	tpy
Propane	0.019	0.084
Isobutane	0.007	0.031
n-Butane	0.016	0.072
Isopentane	0.007	0.030
n-Pentane	0.006	0.028
n-Hexane	0.000	0.001
Methylcyclopentane	0.000	0.001
Benzene	0.000	0.000
Cyclohexane	0.000	0.000
n-Heptane	0.001	0.006
n-Octane	0.000	0.001
n-Nonane	0.000	0.000
n-Decane	0.000	0.000
n-Undecane	0.000	0.000
Dodecane	0.000	0.000
Triethylene Glycol	0.000	0.000
Cyclopentane	0.000	0.000
Isohexane	0.003	0.011
3-Methylpentane	0.001	0.004
Neohexane	0.000	0.001
2,3-Dimethylbutane	0.000	0.002
Methylcyclohexane	0.000	0.001
Isooctane	0.000	0.000
Decane, 2-Methyl-	0.000	0.000
Toluene	0.000	0.000
m-Xylene	0.000	0.000
Ethylbenzene	0.000	0.000
Total Emissions:	0.062	0.273
Total VOC Emissions:	0.062	0.273
Total HAP Emissions:	0.00	0.01

Micro Turbine Generator Emissions (Per Turbine)
(TRB-1, TRB-2)

Source Designation:	
Manufacturer:	Capstone
Model No.:	C200
Year Installed:	TBD
Type of Engine:	MicroTurbine
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,265
Rated Power Output (kW):	200
Rated Horsepower (bhp):	272
Heat Input (MMBtu/hr)	2.28
Maximum Fuel Consumption at 100% Load (MMscf/hr):	0.00180
Maximum Fuel Consumption at 100% Load (MMscf/yr):	15.8

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMBtu/yr):	19,973

Criteria and Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units
NO_x[b]	4.00E-01	lb/MWh
CO[b]	1.10E+00	lb/MWh
SO_2[a]	3.40E-03	lb/MMBtu
Total Particulate Matter (TSP)[a]	6.60E-03	lb/MMBtu
PM (Filterable)[a]	1.90E-03	lb/MMBtu
PM_{10} (Filterable + Condensable)[a]	6.60E-03	lb/MMBtu
$PM_{2.5}$ (Filterable + Condensable)[a]	6.60E-03	lb/MMBtu
VOC[b]	1.00E-01	lb/MWh
CO_2[b]	1.33E+03	lb/MWh
CH_4[c]	1.00E-03	kg/MMBtu
N_2O[c]	1.00E-04	kg/MMBtu

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[d,e,f]	Potential Emissions (tons/yr)[g]
NO_x	0.08	0.35
CO	0.22	0.96
SO_2	0.008	0.03
Total Particulate Matter (TSP)	0.02	0.07
PM (Filterable)	0.00	0.02
PM_{10} (Filterable + Condensable)	0.02	0.07
$PM_{2.5}$ (Filterable + Condensable)	0.02	0.07
VOC	0.02	0.09
CO_2	266.00	1165.08
CH_4	0.01	0.02
N_2O	0.00	0.00

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMBtu)[a]	Potential Emissions (lb/hr)[e]	Potential Emissions (tons/yr)[g]
HAPs:			
Acetaldehyde	4.00E-05	9.12E-05	3.99E-04
Acrolein	6.40E-06	1.46E-05	6.39E-05
Benzene	1.20E-05	2.74E-05	1.20E-04
1,3-Butadiene	4.30E-07	9.80E-07	4.29E-06
Ethylbenzene	3.20E-05	7.30E-05	3.20E-04
Formaldehyde	7.10E-04	1.62E-03	7.09E-03
Propylene Oxide	2.90E-05	6.61E-05	2.90E-04
Toluene	1.30E-04	2.96E-04	1.30E-03
Xylene	6.40E-05	1.46E-04	6.39E-04
Polycyclic Organic Matter:			
Naphthalene	1.30E-06	2.96E-06	1.30E-05
PAH	2.20E-06	5.02E-06	2.20E-05
Total HAP		**2.34E-03**	**1.03E-02**

[a] Emission factor from AP-42 Section 3.1, "Stationary Gas Turbines," Tables 3.1-1, 3.1-2a, and 3.1-3, April 2000.
[b] NOx, CO, VOC, and CO_2 emission factors from Capstone C65 Natural Gas Low NOx MicroTurbine Specification Sheet.
[c] Greenhouse gas emission factors are from 40 CFR Part 98 for natural gas combustion.
[d] Emission Rate (lb/hr) = Rated Horsepower (bhp) x Emission Factor (g/bhp-hr) x 2.2046 (lb/kg) / 1000 (g/kg)
[e] Emission Rate (lb/hr) = Rated Output (kW) × Emission Factor (lb/MWh) / 1000 (kW/MW).
[f] Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (kg/MMBtu) x 2.2046 (lb/kg)
[g] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8,760 hr/yr) × (1 ton/2000 lb).

Blowdown Flare (BDF-1) Emissions Calculations:

Blowdown Flare Rating	100	MMscfd
Blowdown Events Per Year	5	
Blowdown Events Duration	5	minute
Pilot Rating	65	scfh (each 2 total)
Higher Heating Value (HHV)	1,265	btu/scf
Control Efficiency	98%	

Pollutant	Pilot Emission Factors [1] (lb/MMBtu)	Flare Emission Factors [2] (lb/MMBtu)	Pilot Combustion Potential Emissions (lb/hr)	Pilot Combustion Potential Emissions (tpy)	Flare Potential Emissions (lb/hr)	Flare Potential Emissions (tpy)
NO_x	0.079	0.068	0.01	0.06	358.50	0.07
CO	0.066	0.370	0.01	0.05	1950.64	0.41
PM/PM_{10}	0.006	0.000	0.00	0.00	0.00	0.00
SO_2	0.000	0.000	0.00	0.00	0.00	0.00
CO_2 [3] (Natural Gas Firing)	116.997		19.24	84	616,810	128.50
CH_4 [3] (Natural Gas Firing)	0.002		0.00	0.00	11.62	0.00
N_2O [3] (Natural Gas Firing)	0.000		0.00	0.000	1.16	0.00

1. Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3 & 1.4-4.
2. Emission factors from AP-42 Section 13.5 "Industrial Flares" - assumes smokeless and negligible sulfur content.
3. GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Gas Analysis

Higher Heating Value 1,265 btu/scf

Constituent	Concentration (Vol %)	Molecular Weight	Molar Weight	Average Weight Fraction	Natural Gas Stream Speciation (Wt. %)
Carbon Dioxide	0.1582%	44.01	0.07	0.00	0.33
Nitrogen	0.4531%	28.02	0.13	0.01	0.60
Methane	77.9572%	16.04	12.50	0.59	59.31
Ethane	13.5630%	30.07	4.08	0.19	19.34
Propane	4.3663%	44.10	1.93	0.09	9.13
Isobutane	0.6609%	58.12	0.38	0.02	1.82
n-Butane	1.2755%	58.12	0.74	0.04	3.52
Isopentane	0.4220%	72.15	0.30	0.01	1.44
n-Pentane	0.4120%	72.15	0.30	0.01	1.41
Cyclopentane	0.0000%	70.1	0.00	0.00	0.00
n-Hexane*	0.1789%	86.18	0.15	0.01	0.73
Cyclohexane	0.0240%	84.16	0.02	0.00	0.10
Other Hexanes	0.2971%	86.18	0.26	0.01	1.21
Heptanes	0.1321%	100.20	0.13	0.01	0.63
Methylcyclohexane	0.0392%	98.19	0.04	0.00	0.18
2,2,4-Trimethylpentane*	0.0008%	114.23	0.00	0.00	0.00
Benzene*	0.0072%	78.11	0.01	0.00	0.03
Toluene*	0.0091%	92.14	0.01	0.00	0.04
Ethylbenzene*	0.0000%	106.17	0.00	0.00	0.00
Xylenes*	0.0015%	106.16	0.00	0.00	0.01
C8+ Heavies	0.0292%	114.23	0.03	0.00	0.16
Totals	100.0%		21.08	1.00	100.00

*HAPs

TOC (Total)	99.38%	99.07
VOC (Total)	7.86%	20.41
HAP (Total)	0.20%	0.81

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: Oxford Station
File Name: Z:\Client\CONSOL\Corporate\153901.0007 Oxford Updates\Deliverables\20150311 Draft R13 Modification\Attachment N - Emission Calculations\20150304_DEHY 67 MMSCFD_ (OXF 021915 Sample).ddf
Date: March 11, 2015

DESCRIPTION:

Description: 67 MMSCFD DEHY UNIT
2/19/2015 Sample

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 100.00 deg. F
Pressure: 450.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	0.1582
Nitrogen	0.4531
Methane	77.9572
Ethane	13.5630
Propane	4.3663
Isobutane	0.6609
n-Butane	1.2755
Isopentane	0.4220
n-Pentane	0.4120
n-Hexane	0.1789
Cyclohexane	0.0240
Other Hexanes	0.2971
Heptanes	0.1321
Methylcyclohexane	0.0392
2,2,4-Trimethylpentane	0.0008
Benzene	0.0072
Toluene	0.0091
Xylenes	0.0015
C8+ Heavies	0.0292

DRY GAS:

Flow Rate: 67.0 MMSCF/day
Water Content: 5.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 1.5 wt% H2O
Flow Rate: 7.5 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

FLASH TANK:

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Temperature: 130.0 deg. F
Pressure: 35.0 psig

REGENERATOR OVERHEADS CONTROL DEVICE:

Control Device: Combustion Device
Destruction Efficiency: 98.0 %
Excess Oxygen: 2.0 %
Ambient Air Temperature: 70.0 deg. F

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Oxford Station
File Name: Z:\Client\CONSOL\Corporate\153901.0007 Oxford Updates\Draft\20150304 Draft R13 Modification\Attachment N - Emission Calculations\20150304_DEHY 67 MMSCFD_ (OXF 021915 Sample).ddf
Date: March 04, 2015

DESCRIPTION:

Description: 67 MMSCFD DEHY UNIT
2/19/2015 Sample

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0099	0.237	0.0432
Ethane	0.0127	0.304	0.0555
Propane	0.0187	0.448	0.0817
Isobutane	0.0063	0.151	0.0276
n-Butane	0.0182	0.437	0.0798
Isopentane	0.0085	0.205	0.0374
n-Pentane	0.0117	0.282	0.0514
n-Hexane	0.0138	0.332	0.0606
Cyclohexane	0.0129	0.310	0.0566
Other Hexanes	0.0150	0.360	0.0657
Heptanes	0.0314	0.754	0.1375
Methylcyclohexane	0.0318	0.763	0.1392
2,2,4-Trimethylpentane	0.0001	0.002	0.0003
Benzene	0.0489	1.174	0.2143
Toluene	0.1117	2.681	0.4892
Xylenes	0.0488	1.172	0.2139
C8+ Heavies	0.1173	2.815	0.5137
Total Emissions	0.5177	12.426	2.2677
Total Hydrocarbon Emissions	0.5177	12.426	2.2677
Total VOC Emissions	0.4952	11.885	2.1690
Total HAP Emissions	0.2234	5.361	0.9784
Total BTEX Emissions	0.2095	5.027	0.9175

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.4937	11.849	2.1624
Ethane	0.6335	15.204	2.7747
Propane	0.9328	22.387	4.0857
Isobutane	0.3153	7.568	1.3811
n-Butane	0.9109	21.862	3.9898
Isopentane	0.4268	10.242	1.8692
n-Pentane	0.5869	14.085	2.5706
n-Hexane	0.6915	16.595	3.0286

Cyclohexane	0.6459	15.501	2.8290
Other Hexanes	0.7503	18.006	3.2861
Heptanes	1.5701	37.682	6.8770
Methylcyclohexane	1.5887	38.130	6.9587
2,2,4-Trimethylpentane	0.0036	0.086	0.0156
Benzene	2.4467	58.721	10.7166
Toluene	5.5848	134.035	24.4615
Xylenes	2.4422	58.612	10.6967
C8+ Heavies	5.8639	140.733	25.6838
Total Emissions	25.8875	621.300	113.3872
Total Hydrocarbon Emissions	25.8875	621.300	113.3872
Total VOC Emissions	24.7603	594.247	108.4501
Total HAP Emissions	11.1687	268.049	48.9190
Total BTEX Emissions	10.4737	251.368	45.8747

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.8954	21.490	3.9220
Ethane	0.3622	8.693	1.5864
Propane	0.2113	5.071	0.9254
Isobutane	0.0490	1.177	0.2148
n-Butane	0.1082	2.597	0.4739
Isopentane	0.0457	1.097	0.2003
n-Pentane	0.0506	1.215	0.2218
n-Hexane	0.0343	0.824	0.1503
Cyclohexane	0.0091	0.219	0.0401
Other Hexanes	0.0495	1.188	0.2168
Heptanes	0.0403	0.966	0.1764
Methylcyclohexane	0.0177	0.425	0.0776
2,2,4-Trimethylpentane	0.0002	0.004	0.0008
Benzene	0.0041	0.099	0.0180
Toluene	0.0063	0.151	0.0275
Xylenes	0.0011	0.026	0.0047
C8+ Heavies	0.0161	0.386	0.0704
Total Emissions	1.9011	45.627	8.3269
Total Hydrocarbon Emissions	1.9011	45.627	8.3269
Total VOC Emissions	0.6435	15.444	2.8186
Total HAP Emissions	0.0460	1.103	0.2014
Total BTEX Emissions	0.0115	0.275	0.0503

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	44.7712	1074.509	196.0978
Ethane	18.1095	434.627	79.3194
Propane	10.5638	253.531	46.2694
Isobutane	2.4515	58.836	10.7375
n-Butane	5.4094	129.826	23.6932
Isopentane	2.2862	54.869	10.0136
n-Pentane	2.5314	60.754	11.0876
n-Hexane	1.7157	41.176	7.5146
Cyclohexane	0.4572	10.973	2.0026
Other Hexanes	2.4751	59.403	10.8411

Heptanes	2.0135	48.324	8.8191
Methylcyclohexane	0.8856	21.255	3.8790
2,2,4-Trimethylpentane	0.0092	0.222	0.0405
Benzene	0.2056	4.933	0.9003
Toluene	0.3141	7.538	1.3756
Xylenes	0.0540	1.297	0.2367
C8+ Heavies	0.8033	19.278	3.5183
Total Emissions	95.0562	2281.350	416.3463
Total Hydrocarbon Emissions	95.0562	2281.350	416.3463
Total VOC Emissions	32.1756	772.214	140.9291
Total HAP Emissions	2.2986	55.166	10.0677
Total BTEX Emissions	0.5737	13.768	2.5126

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.9053	21.727	3.9652
Ethane	0.3749	8.997	1.6419
Propane	0.2299	5.518	1.0071
Isobutane	0.0553	1.328	0.2424
n-Butane	0.1264	3.034	0.5537
Isopentane	0.0543	1.302	0.2377
n-Pentane	0.0624	1.497	0.2732
n-Hexane	0.0481	1.155	0.2109
Cyclohexane	0.0221	0.529	0.0966
Other Hexanes	0.0645	1.548	0.2825
Heptanes	0.0717	1.720	0.3139
Methylcyclohexane	0.0495	1.188	0.2168
2,2,4-Trimethylpentane	0.0003	0.006	0.0011
Benzene	0.0530	1.273	0.2323
Toluene	0.1180	2.831	0.5167
Xylenes	0.0499	1.198	0.2187
C8+ Heavies	0.1333	3.200	0.5840
Total Emissions	2.4189	58.053	10.5947
Total Hydrocarbon Emissions	2.4189	58.053	10.5947
Total VOC Emissions	1.1387	27.329	4.9876
Total HAP Emissions	0.2693	6.464	1.1797
Total BTEX Emissions	0.2209	5.303	0.9677

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
Methane	198.2602	3.9652	98.00
Ethane	82.0942	1.6419	98.00
Propane	50.3551	1.0071	98.00
Isobutane	12.1186	0.2424	98.00
n-Butane	27.6830	0.5537	98.00
Isopentane	11.8829	0.2377	98.00
n-Pentane	13.6582	0.2732	98.00
n-Hexane	10.5432	0.2109	98.00
Cyclohexane	4.8316	0.0966	98.00

Other Hexanes	14.1272	0.2825	98.00
Heptanes	15.6961	0.3139	98.00
Methylcyclohexane	10.8377	0.2168	98.00
2,2,4-Trimethylpentane	0.0562	0.0011	98.00
Benzene	11.6169	0.2323	98.00
Toluene	25.8371	0.5167	98.00
Xylenes	10.9333	0.2187	98.00
C8+ Heavies	29.2021	0.5840	98.00
Total Emissions	529.7335	10.5947	98.00
Total Hydrocarbon Emissions	529.7335	10.5947	98.00
Total VOC Emissions	249.3792	4.9876	98.00
Total HAP Emissions	58.9867	1.1797	98.00
Total BTEX Emissions	48.3874	0.9677	98.00

EQUIPMENT REPORTS:

COMBUSTION DEVICE

Ambient Temperature: 70.00 deg. F
Excess Oxygen: 2.00 %
Combustion Efficiency: 98.00 %
Supplemental Fuel Requirement: 2.10e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	2.00%	98.00%
Ethane	2.00%	98.00%
Propane	2.00%	98.00%
Isobutane	2.00%	98.00%
n-Butane	2.00%	98.00%
Isopentane	2.00%	98.00%
n-Pentane	2.00%	98.00%
n-Hexane	2.00%	98.00%
Cyclohexane	2.00%	98.00%
Other Hexanes	2.00%	98.00%
Heptanes	2.00%	98.00%
Methylcyclohexane	2.00%	98.00%
2,2,4-Trimethylpentane	2.00%	98.00%
Benzene	2.00%	98.00%
Toluene	2.00%	98.00%
Xylenes	2.00%	98.00%
C8+ Heavies	2.00%	98.00%

ABSORBER

Calculated Absorber Stages: 2.27
Specified Dry Gas Dew Point: 5.00 lbs. H2O/MMSCF
Temperature: 100.0 deg. F
Pressure: 450.0 psig
Dry Gas Flow Rate: 67.0000 MMSCF/day
Glycol Losses with Dry Gas: 0.4817 lb/hr
Wet Gas Water Content: Saturated
Calculated Wet Gas Water Content: 109.49 lbs. H2O/MMSCF

Calculated Lean Glycol Recirc. Ratio: 1.54 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.56%	95.44%
Carbon Dioxide	99.92%	0.08%
Nitrogen	99.99%	0.01%
Methane	99.99%	0.01%
Ethane	99.98%	0.02%
Propane	99.96%	0.04%
Isobutane	99.95%	0.05%
n-Butane	99.93%	0.07%
Isopentane	99.92%	0.08%
n-Pentane	99.90%	0.10%
n-Hexane	99.83%	0.17%
Cyclohexane	99.30%	0.70%
Other Hexanes	99.87%	0.13%
Heptanes	99.68%	0.32%
Methylcyclohexane	99.17%	0.83%
2,2,4-Trimethylpentane	99.85%	0.15%
Benzene	93.64%	6.36%
Toluene	90.48%	9.52%
Xylenes	78.75%	21.25%
C8+ Heavies	98.22%	1.78%

FLASH TANK

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Flash Temperature: 130.0 deg. F
Flash Pressure: 35.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.82%	0.18%
Carbon Dioxide	11.83%	88.17%
Nitrogen	1.00%	99.00%
Methane	1.09%	98.91%
Ethane	3.38%	96.62%
Propane	8.11%	91.89%
Isobutane	11.40%	88.60%
n-Butane	14.41%	85.59%
Isopentane	16.00%	84.00%
n-Pentane	19.10%	80.90%
n-Hexane	29.01%	70.99%
Cyclohexane	59.80%	40.20%
Other Hexanes	23.83%	76.17%
Heptanes	44.06%	55.94%
Methylcyclohexane	65.57%	34.43%
2,2,4-Trimethylpentane	28.69%	71.31%
Benzene	92.63%	7.37%
Toluene	95.09%	4.91%
Xylenes	98.11%	1.89%
C8+ Heavies	89.37%	10.63%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	17.82%	82.18%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	2.00%	98.00%
n-Pentane	1.82%	98.18%
n-Hexane	1.37%	98.63%
Cyclohexane	5.05%	94.95%
Other Hexanes	3.14%	96.86%
Heptanes	1.00%	99.00%
Methylcyclohexane	5.81%	94.19%
2,2,4-Trimethylpentane	4.05%	95.95%
Benzene	5.36%	94.64%
Toluene	8.27%	91.73%
Xylenes	13.12%	86.88%
C8+ Heavies	13.14%	86.86%

STREAM REPORTS:

WET GAS STREAM

Temperature: 100.00 deg. F
Pressure: 464.70 psia
Flow Rate: 2.80e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.31e-001	3.06e+002
Carbon Dioxide	1.58e-001	5.12e+002
Nitrogen	4.52e-001	9.34e+002
Methane	7.78e+001	9.20e+004
Ethane	1.35e+001	3.00e+004
Propane	4.36e+000	1.42e+004
Isobutane	6.59e-001	2.83e+003
n-Butane	1.27e+000	5.46e+003
Isopentane	4.21e-001	2.24e+003
n-Pentane	4.11e-001	2.19e+003
n-Hexane	1.79e-001	1.13e+003
Cyclohexane	2.39e-002	1.49e+002
Other Hexanes	2.96e-001	1.88e+003
Heptanes	1.32e-001	9.74e+002
Methylcyclohexane	3.91e-002	2.83e+002
2,2,4-Trimethylpentane	7.98e-004	6.73e+000
Benzene	7.18e-003	4.14e+001
Toluene	9.08e-003	6.17e+001
Xylenes	1.50e-003	1.17e+001
C8+ Heavies	2.91e-002	3.66e+002

Total Components	100.00	1.56e+005

DRY GAS STREAM

Temperature: 100.00 deg. F
Pressure: 464.70 psia
Flow Rate: 2.79e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.05e-002	1.40e+001
Carbon Dioxide	1.58e-001	5.12e+002
Nitrogen	4.53e-001	9.34e+002
Methane	7.80e+001	9.20e+004
Ethane	1.36e+001	3.00e+004
Propane	4.37e+000	1.42e+004
Isobutane	6.61e-001	2.83e+003
n-Butane	1.27e+000	5.45e+003
Isopentane	4.22e-001	2.24e+003
n-Pentane	4.12e-001	2.19e+003
n-Hexane	1.79e-001	1.13e+003
Cyclohexane	2.38e-002	1.48e+002
Other Hexanes	2.97e-001	1.88e+003
Heptanes	1.32e-001	9.71e+002
Methylcyclohexane	3.89e-002	2.81e+002
2,2,4-Trimethylpentane	7.99e-004	6.72e+000
Benzene	6.74e-003	3.88e+001
Toluene	8.24e-003	5.58e+001
Xylenes	1.18e-003	9.23e+000
C8+ Heavies	2.87e-002	3.60e+002
Total Components	100.00	1.55e+005

LEAN GLYCOL STREAM

Temperature: 100.00 deg. F
Flow Rate: 7.50e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	4.15e+003
Water	1.50e+000	6.33e+001
Carbon Dioxide	9.83e-013	4.15e-011
Nitrogen	1.28e-013	5.39e-012
Methane	4.13e-018	1.74e-016
Ethane	6.35e-008	2.68e-006
Propane	5.14e-009	2.17e-007
Isobutane	1.09e-009	4.61e-008
n-Butane	2.32e-009	9.78e-008
Isopentane	2.07e-004	8.73e-003
n-Pentane	2.58e-004	1.09e-002
n-Hexane	2.28e-004	9.61e-003
Cyclohexane	8.14e-004	3.43e-002
Other Hexanes	5.76e-004	2.43e-002
Heptanes	3.76e-004	1.59e-002
Methylcyclohexane	2.32e-003	9.80e-002
2,2,4-Trimethylpentane	3.57e-006	1.51e-004

Benzene	3.29e-003	1.39e-001
Toluene	1.19e-002	5.04e-001
Xylenes	8.74e-003	3.69e-001
C8+ Heavies	2.10e-002	8.87e-001
Total Components	100.00	4.22e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 100.00 deg. F
Pressure: 464.70 psia
Flow Rate: 8.33e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	8.96e+001	4.15e+003
Water	7.69e+000	3.56e+002
Carbon Dioxide	1.38e-002	6.38e-001
Nitrogen	9.95e-003	4.61e-001
Methane	9.78e-001	4.53e+001
Ethane	4.05e-001	1.87e+001
Propane	2.48e-001	1.15e+001
Isobutane	5.98e-002	2.77e+000
n-Butane	1.37e-001	6.32e+000
Isopentane	5.88e-002	2.72e+000
n-Pentane	6.76e-002	3.13e+000
n-Hexane	5.22e-002	2.42e+000
Cyclohexane	2.46e-002	1.14e+000
Other Hexanes	7.02e-002	3.25e+000
Heptanes	7.78e-002	3.60e+000
Methylcyclohexane	5.56e-002	2.57e+000
2,2,4-Trimethylpentane	2.80e-004	1.30e-002
Benzene	6.03e-002	2.79e+000
Toluene	1.38e-001	6.40e+000
Xylenes	6.19e-002	2.86e+000
C8+ Heavies	1.63e-001	7.55e+000
Total Components	100.00	4.63e+003

FLASH TANK OFF GAS STREAM

Temperature: 130.00 deg. F
Pressure: 49.70 psia
Flow Rate: 1.52e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.79e-001	6.32e-001
Carbon Dioxide	3.20e-001	5.62e-001
Nitrogen	4.08e-001	4.56e-001
Methane	6.99e+001	4.48e+001
Ethane	1.51e+001	1.81e+001
Propane	6.00e+000	1.06e+001
Isobutane	1.06e+000	2.45e+000
n-Butane	2.33e+000	5.41e+000
Isopentane	7.93e-001	2.29e+000
n-Pentane	8.79e-001	2.53e+000

n-Hexane	4.98e-001	1.72e+000
Cyclohexane	1.36e-001	4.57e-001
Other Hexanes	7.19e-001	2.48e+000
Heptanes	5.03e-001	2.01e+000
Methylcyclohexane	2.26e-001	8.86e-001
2,2,4-Trimethylpentane	2.03e-003	9.25e-003
Benzene	6.59e-002	2.06e-001
Toluene	8.53e-002	3.14e-001
Xylenes	1.27e-002	5.40e-002
C8+ Heavies	1.18e-001	8.03e-001
Total Components	100.00	9.67e+001

FLASH TANK GLYCOL STREAM

Temperature: 130.00 deg. F
Flow Rate: 8.12e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.15e+001	4.15e+003
Water	7.84e+000	3.55e+002
Carbon Dioxide	1.66e-003	7.54e-002
Nitrogen	1.01e-004	4.60e-003
Methane	1.09e-002	4.94e-001
Ethane	1.40e-002	6.34e-001
Propane	2.06e-002	9.33e-001
Isobutane	6.96e-003	3.15e-001
n-Butane	2.01e-002	9.11e-001
Isopentane	9.61e-003	4.35e-001
n-Pentane	1.32e-002	5.98e-001
n-Hexane	1.55e-002	7.01e-001
Cyclohexane	1.50e-002	6.80e-001
Other Hexanes	1.71e-002	7.75e-001
Heptanes	3.50e-002	1.59e+000
Methylcyclohexane	3.72e-002	1.69e+000
2,2,4-Trimethylpentane	8.21e-005	3.72e-003
Benzene	5.70e-002	2.59e+000
Toluene	1.34e-001	6.09e+000
Xylenes	6.20e-002	2.81e+000
C8+ Heavies	1.49e-001	6.75e+000
Total Components	100.00	4.53e+003

FLASH GAS EMISSIONS

Flow Rate: 6.12e+003 scfh
Control Method: Combustion Device
Control Efficiency: 98.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.16e+001	1.79e+002
Carbon Dioxide	3.78e+001	2.69e+002
Nitrogen	1.01e-001	4.56e-001
Methane	3.46e-001	8.95e-001
Ethane	7.46e-002	3.62e-001

Propane	2.97e-002	2.11e-001
Isobutane	5.23e-003	4.90e-002
n-Butane	1.15e-002	1.08e-001
Isopentane	3.93e-003	4.57e-002
n-Pentane	4.35e-003	5.06e-002
n-Hexane	2.47e-003	3.43e-002
Cyclohexane	6.73e-004	9.14e-003
Other Hexanes	3.56e-003	4.95e-002
Heptanes	2.49e-003	4.03e-002
Methylcyclohexane	1.12e-003	1.77e-002
2,2,4-Trimethylpentane	1.00e-005	1.85e-004
Benzene	3.26e-004	4.11e-003
Toluene	4.22e-004	6.28e-003
Xylenes	6.31e-005	1.08e-003
C8+ Heavies	5.84e-004	1.61e-002
Total Components	100.00	4.50e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 6.27e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	9.81e+001	2.92e+002
Carbon Dioxide	1.04e-002	7.54e-002
Nitrogen	9.93e-004	4.60e-003
Methane	1.86e-001	4.94e-001
Ethane	1.27e-001	6.33e-001
Propane	1.28e-001	9.33e-001
Isobutane	3.28e-002	3.15e-001
n-Butane	9.48e-002	9.11e-001
Isopentane	3.58e-002	4.27e-001
n-Pentane	4.92e-002	5.87e-001
n-Hexane	4.86e-002	6.91e-001
Cyclohexane	4.64e-002	6.46e-001
Other Hexanes	5.27e-002	7.50e-001
Heptanes	9.48e-002	1.57e+000
Methylcyclohexane	9.79e-002	1.59e+000
2,2,4-Trimethylpentane	1.89e-004	3.57e-003
Benzene	1.90e-001	2.45e+000
Toluene	3.67e-001	5.58e+000
Xylenes	1.39e-001	2.44e+000
C8+ Heavies	2.08e-001	5.86e+000
Total Components	100.00	3.18e+002

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 2.38e+000 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	9.81e+000	9.87e-003
Ethane	6.71e+000	1.27e-002

Propane	6.74e+000	1.87e-002
Isobutane	1.73e+000	6.31e-003
n-Butane	4.99e+000	1.82e-002
Isopentane	1.88e+000	8.54e-003
n-Pentane	2.59e+000	1.17e-002
n-Hexane	2.56e+000	1.38e-002
Cyclohexane	2.45e+000	1.29e-002
Other Hexanes	2.77e+000	1.50e-002
Heptanes	4.99e+000	3.14e-002
Methylcyclohexane	5.16e+000	3.18e-002
2,2,4-Trimethylpentane	9.96e-003	7.14e-005
Benzene	9.98e+000	4.89e-002
Toluene	1.93e+001	1.12e-001
Xylenes	7.33e+000	4.88e-002
C8+ Heavies	1.10e+001	1.17e-001
Total Components	100.00	5.18e-001

Legacy Measurement Solutions

Shreveport, LA

318-226-7237

Good

LELAP Certification #

04049

Customer	: 2325 - CNX GAS COMPANY LLC	**Date Sampled**	: 02/19/2015
Station ID	: 5001	**Date Analyzed**	: 02/26/2015
Cylinder ID	: 3006	**Effective Date**	: 03/01/2015
Producer	:	**Cyl Pressure**	: 500
Lease	: OXFORD STATION INLET	**Temp**	: 63
Area	: 941 - WEST VIRGINIA	**Cylinder Type**	: Spot
State	: WV	**Sample By**	: ML

COMPONENT	MOL%	GPM@14.73(PSIA)
Methane	77.9572	0.000
Ethane	13.5630	3.640
Propane	4.3663	1.207
Iso-Butane	0.6609	0.217
Normal-Butane	1.2755	0.404
Iso-Pentane	0.4220	0.155
Normal-Pentane	0.4120	0.150
Nitrogen	0.4531	0.000
Carbon-Dioxide	0.1582	0.000
Oxygen	0.0127	0.000
BENZENE	0.0072	0.002
TOLUENE	0.0091	0.003
2,2-Dimethylbutane	0.0143	0.006
2,3-Dimethylbutane/CycloC5	0.0339	0.012
2-methylpentane	0.1369	0.057
3-methylpentane	0.0821	0.034
Normal-Hexane	0.1789	0.074
2,2-Dimethylpentane	0.0019	0.001
Methylcyclopentane	0.0299	0.011
3,3-Dimethylpentane	0.0000	0.000
CYCLOHEXANE	0.0240	0.008
2-Methylhexane	0.0363	0.017
2,3-Dimethylpentane	0.0085	0.003
3-Methylhexane	0.0356	0.016
1,t3-Dimethylcyclopentane	0.0009	0.000
1,t2-DMCYC5 / 2,2,4-TMC5	0.0008	0.000
N-Heptane	0.0489	0.023
METHYLCYCLOHEXANE	0.0392	0.018
2,5-Dimethylhexane	0.0016	0.001
2,3-Dimethylhexane	0.0028	0.001
2-Methylheptane	0.0059	0.003
4-Methylheptane	0.0020	0.001
3-Methylheptane	0.0046	0.002
1,t4-Dimethylcyclohexane	0.0039	0.002
N-OCTANE / 1,T2-DMCYC6	0.0057	0.003
1,t3-DMCYC6/1,C4-DMCYC6/1,C2,C3-TMCYC5	0.0002	0.000
2,4,4 TMC6	0.0000	0.000
2,6-Dimethylheptane / 1,C2-DMCYC6	0.0010	0.001

Ethylcyclohexane	0.0000	0.000
M-Xylene/P-Xylene	0.0015	0.001
O-XYLENE	0.0000	0.000
NONANE	0.0011	0.001
N-DECANE	0.0000	0.000
N-UNDECANE	0.0004	0.000
TOTAL	**100.0000**	**6.074**

Compressibility Factor (Z) @ 14.73 @ 60 Deg. F = 0.9963 **C5+ GPM** : 0.60600

Ideal Gravity: 0.7282 **Real Gravity:** 0.7306 **C5+ Mole %** : 1.5531

BTU @ (PSIA)	@14.65	@14.696	@14.73	@15.025
Ideal GPM	6.017	6.035	6.049	6.171
Ideal BTU Dry	1,265.28	1,269.25	1,272.19	1,297.67
Ideal BTU Sat	1,243.14	1,247.11	1,250.05	1,275.52
Real GPM	6.039	6.058	6.072	6.194
Real BTU Dry	1,269.99	1,273.99	1,276.95	1,302.62
Real BTU Sat	1,248.28	1,252.28	1,255.24	1,280.92

Comments:

Gas Analysis performed in accordance with GPA 2286 **Sample Count** : 210000009

Analytical Calculations performed in accordance with GPA 2172 **COC** :

Measurement Analyst: ______________________________ **DEBORAH J MURPHY**

Capstone Turbine Corporation • 21211 Nordhoff Street • Chatsworth • CA 91311 • USA
Phone: (818) 734-5300 • Fax: (818) 734-5320 • Web: www.microturbine.com

Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.22	0.60	0.078
CR30 MBTU	Landfill Gas (2)	0.22	7.4	0.340
CR30 MBTU	Digester Gas (3)	0.22	3.7	0.340
C30 Liquid	Diesel #2 (4)	0.90	0.14	0.078
C65 NG Standard	Natural Gas (1)	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas (1)	0.06	0.44	0.034
C65 NG CARB	Natural Gas (1)	0.06	0.08	0.017
CR65 Landfill	Landfill Gas (2)	0.16	1.4	0.034
CR65 Digester	Digester Gas (3)	0.16	1.4	0.034
C200 NG	Natural Gas (1)	0.14	0.37	0.034
C200 NG CARB	Natural Gas (1)	0.05	0.07	0.014
CR200 Digester	Digester Gas (3)	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is "ppmvd" (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O_2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O_2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as "electric horsepower-hour")
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com

Product Catalog



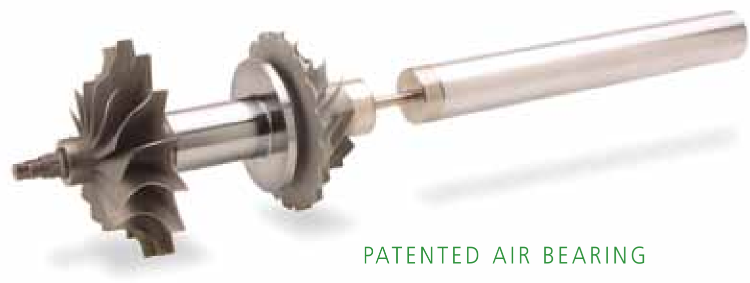

Reliable power when and where you need it.
Clean and simple.

Capstone Microturbines

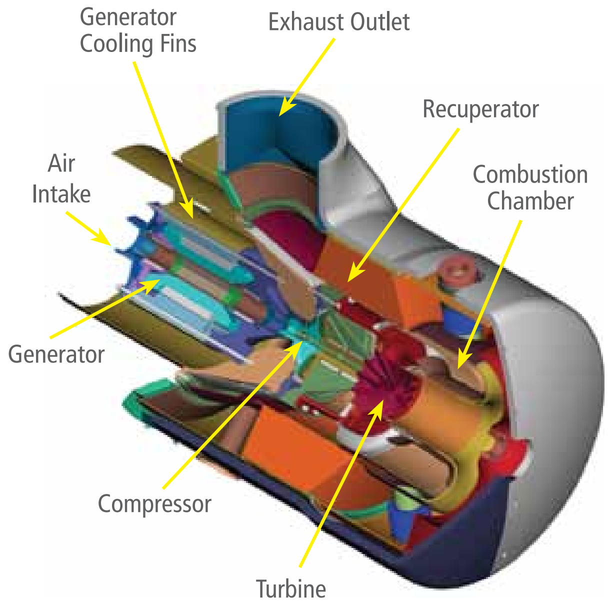
Capstone microturbines are used in distributed power generation applications including cogeneration, resource recovery, secure power, and hybrid electric vehicles (HEV).

Low-emission, clean-and-green Capstone microturbines are scalable from 30kW to 10MW. The C1000 Power Package, the world's first megawatt microturbine power system, can be configured into smaller 800kW and 600kW solutions – all within a single ISO-type container. Models are available that operate on: Natural Gas, Propane, Landfill Gas, Digester Gas, Diesel, Aviation, and Kerosene fuels.

- Ultra-low emissions
- One moving part – minimal maintenance and downtime
- Patented air bearing – no lubricating oil or coolant required
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Integrated synchronization and protection
- Reliable – tens of millions of run hours and counting



PATENTED AIR BEARING



C30

C65

C65 ICHP

C65 CARB

HAZARDOUS LOCATIONS

Model	Fuels	Power Output[1]	Electrical Efficiency	Exhaust Gas Flow		Exhaust Temperature		Net Heat Rate		Dimensions[2] (W x D x H)	
		kW	%	kg/s	lbm/s	C°	F°	MJ/kWh	btu/kWh	m	in
GASEOUS FUELS[3]											
C30 LP	NG	28	25	0.31	0.68	275	530	13.8	13,100	0.76 x 1.5 x 1.8	30 x 60 x 70
C30 HP	NG, P, LG, DG	30	26	0.31	0.68	275	530	13.8	13,100	0.76 x 1.5 x 1.8	30 x 60 x 70
C30 HZLC[4]	NG	30	26	0.32	0.70	275	530	13.8	13,100	0.87 x 2.9 x 2.2	34 x 112 x 85
C65	NG, P	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 1.9 x 1.8	30 x 77 x 76
C65 ICHP	NG, P, LG, DG	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.4	30 x 87 x 93
C65 CARB	NG	65	28	0.51	1.13	311	592	12.9	12,200	0.76 x 2.2 x 2.6	30 x 87 x 103
C65 CARB	LG, DG	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.6	30 x 77 x 85
C65 HZLC[4]	NG	65	29	0.50	1.09	325	617	12.9	12,200	0.87 x 3.2 x 2.3	35 x 128 x 90
C200 LP	NG	190	31	1.3	2.9	280	535	11.6	11,000	1.7 x 3.8 x 2.5	67 x 150 x 98
C200 HP	NG, P, LG, DG	200	33	1.3	2.9	280	535	10.9	10,300	1.7 x 3.8 x 2.5	67 x 150 x 98
C200 HZLC[4]	NG	200	33	1.3	2.9	280	535	10.9	10,300	1.9 x 3.2 x 3.1	74 x 126 x 122
C600 LP	NG	570	31	4.0	8.8	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C600 HP	NG, P, LG, DG	600	33	4.0	8.8	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
C800 LP	NG	760	31	5.3	11.7	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C800 HP	NG, P, LG, DG	800	33	5.3	11.7	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
C1000 LP	NG	950	31	6.7	14.7	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C1000 HP	NG, P, LG, DG	1000	33	6.7	14.7	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
LIQUID FUELS[5]											
C30	D, A, K	29	25	0.31	0.69	275	530	14.4	13,700	0.76 x 1.5 x 1.9	30 x 60 x 70
C65	D, A, K	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 1.9 x 1.8	30 x 77 x 76
C65 ICHP	D, A, K	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.4	30 x 87 x 93
C200	D	190	30	1.3	2.9	280	535	10.9	10,300	1.7 x 3.8 x 2.5	67 x 150 x 98

(1) Nominal full power performance at ISO conditions: 59° F, 14.696 psia, 60% RH
(2) Height dimensions are to the roofline. Exhaust outlet can extend up to 7 inches above the roofline.
(3) Models available to operate on these different fuels: NG – Natural Gas; P – Propane; LG – Landfill Gas; DG – Digester Gas
(4) Hazardous Location units suitable for use in potentially explosive atmospheres (UL Class I, Division 2 or Atex Class I, Zone 2)
(5) Models available to operate on these different fuels: D – Diesel; A – Aviation; K – Kerosene

Specifications are not warrantied and are subject to change without notice.

C200

C1000

Capstone Turbine Corporation® is the world's leading producer of low-emission microturbine systems, and was first to market with commercially viable air bearing turbine technology. The company has shipped thousands of Capstone turbines to customers worldwide. These award-winning systems have logged millions of documented runtime operating hours.

Capstone is a member of the U.S. Environmental Protection Agency's Combined Heat and Power Partnership which is committed to improving the efficiency of the nation's energy infrastructure and reducing emissions of pollutants and greenhouse gases.

A UL-Certified ISO 9001:2008 and ISO 14001:2004 company, Capstone is headquartered in the Los Angeles area with sales and/or service centers in China, Mexico, Singapore, South America, the United Kingdom, and the United States.

For more information about Capstone Turbine Corporation and its clean-and-green microturbine technology solutions, please visit www.capstoneturbine.com or call 818.734.5300.

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ATTACHMENT O

Monitoring/Recordkeeping/Reporting/Testing Plans

ATTACHMENT O - MONITORING, RECORDING, REPORTING, AND TESTING PLANS

Plan Type	Emission unit	Pollutant	Requirements	Frequency	Method of Measurement	Regulatory Reference
Monitoring, Recordkeeping	Storage Tanks	VOC	Monitor throughput of storage tank	Monthly	Records	
Monitoring, Recordkeeping	Gun Barrel Storage Tank (ES-1a)	VOC	AVO inspection of closed vent system	Monthly	Records	NSPS OOOO
Recordkeeping	Dehydration Units	HAP	Maintain benzene emissions below 0.9 megagrams/yr	Annual	GRI-GLYCalc with actual operating parameters	40 CFR 63 Subpart HH

ATTACHMENT P

Public Notice

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that CONE Midstream Partners, LP has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a Modification (R-13) for a Natural Gas Compressor Station (Oxford Station) located near the Town of West Union, in Doddridge County, West Virginia. The site latitude and longitude coordinates are: 39.242516 N, -80.820745 W.

The applicant estimates the potential increase to discharge the following Regulated Air Pollutants as a result of the change will be:

Particulate Matter (PM) = 0.6 tpy
Sulfur Dioxide (SO2) = 0.1 tpy
Volatile Organic Compounds (VOC) = 85.1 tpy
Carbon Monoxide (CO) = 6.8 tpy
Nitrogen Oxides (NOx) = 6.5 tpy
Hazardous Air Pollutants (HAPs) = 8.7tpy
Carbon Dioxide Equivalents (CO_2e) = 6,185 tpy

This facility is currently in operation and is seeking to increase the current throughput for the existing dehydration unit and add three (3) storage tanks, two (2) microturbines, one (1) additional dehydration unit with associated reboiler, and enclosed combustor, and one (1) blowdown flare. Startup of operations is planned to begin upon permit issuance. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1227, during normal business hours.

Dated this the XX day of February, 2015.

By: CONE Midstream Partners, LP
David Morris
1000 CONSOL Energy Drive
Canonsburg, PA 15317